The Journal

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

IMPERIAL COLLEGE AND RESEARCH INSTITUTE
No. 1324
26 MAY 1930

ISSUED QUARTERLY.

VOLUME III.

JULY 1909—APRIL 1910.

Edited by:

ALLEYNE LEECHMAN, F.C.S.,

Science Lecturer,

Department of Science and Agriculture.

DEMERARA:

PRINTED BY "THE ARGOSY" COMPANY, LIMITED.

1911.

NOTICE.

The Scientific and Technical Department of The Imperial Institute.

His Excellency the Governor has received a despatch from the Right Honourable the Secretary of State for the Colonies calling attention to the advantages offered by the Imperial Institute to merchants, planters and others who may wish to have samples submitted to scientific experts for opinion as to their commercial value, etc. The following extracts from a memorandum published by the Authorities of the Imperial Institute will give an idea of the work undertaken and carried on there.

"The Scientific and Technical Department of the Institute has been established to acquire information by special inquiries and by experimental research, technical trials and commercial valuation, regarding new or little known natural or manufactured products of the various colonies and dependencies of the British Empire and of foreign countries, and also regarding known products procurable from new sources, and local products of manufacture which it is desired to export. This work is carried out with a view to the creation of new openings in trade, or the promotion of industrial developments."

2. In an extensive and well-equipped series of research laboratories, a numerous staff of skilled chemists carries out the investigation of the chemical constitution and properties of new dye stuffs, tanning materials, seed and foodstuffs, oils, gums and resins, fibre, timbers, medicinal plants and products, with a view to their commercial utilization. Whenever necessary, these materials are submitted to special scientific experts, by whom they are made the subject of particular investigation or practical test. Reports are also obtained from technical or trade experts in regard to the probable commercial or industrial value of any such products.

3. The British Guiana Government has undertaken to grant a sum of £150 a year to the Department with a view to the careful investigation and commercial development of the resources of the colony.

The Director of Science and Agriculture is collecting specimens for examination, and the Imperial Institute, which is in very

complete touch with the principal manufacturing and other industries of the United Kingdom, will bring the specimens before manufacturers and others for trial with a view to their commercial development.

It is expected that this action will do much to help in finding a market for new products and developing the market for those already exploited.

Planters and residents in British Guiana are at liberty to send (through the Director of Science and Agriculture) specimens of little known or new vegetable or mineral products of the colony for examination at the Imperial Institute, by whom a report will be made through the Government Secretary. Specimens should, if possible, consist of a few pounds of the materials, and should be accompanied by full information, especially respecting the precise locality in which the material is found and the extent of its occurrence.

Attention may also be drawn to the "Bulletin of the Imperial Institute," published quarterly, which contains records of the investigations conducted at the Imperial Institute, and special articles on tropical agriculture and the commercial and industrial uses of vegetable and mineral products. Copies of this publication, price 4s. 4d. per annum (including postage), may be ordered through "The Argosy" Company, Limited.

Special sample-rooms have been arranged at the Imperial Institute, for the information of inquirers in which materials which have been investigated and valued are available for reference.

Important products are also shown in the British Guiana Court in the Public Galleries of the Imperial Institute.

Communications should be addressed to the Director, Imperial Institute, South Kensington, London, S. W.

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL. III. OCTOBER, 1909. No. 2

The Demerara Silk Worm.

Tucked away in a corner of the colony Museum, in a neat glazed case, is an interesting exhibit of an interesting insect—*Attacus hesperus* or the "Demerara Silk-worm." Time and light and climate have sobered the hues of the moth and shrivelled the larva; but in life the adult form is a splendid creature, broad of wing and magnificent in the tone and blending of its hues, while the caterpillar displays a barbaric crudity of colour which is almost startling. On a ground of Cambridge blue are broadly drawn stripes of vivid chrome-orange relieved by gaudy spots and lamp-black streaks which run down and cover the ventral or 'prop' legs. But the colour of the animal is a secondary consideration; it is its prospective utility which concerns us. The larva spins a cocoon to protect itself while in the pupa state; the silk of which this cocoon is made may have a value; and this value may be turned to account. We say 'may,' because we understand that something in that direction has already been done, and definite information may be expected at any moment.

Already the question of establishing a silk industry locally is exercising the mind of more than one tropical colony. Uganda, British East Africa and Ceylon have been, and are devoting their attention to the production of wild and cultivated silks, while in India, of course, much work on the problem has been done. In addition to the mulberry silk worm, *Bombyx mori*, there are several varieties of silk-moths, the larvae of which are capable of producing silk in sufficient quantity and of such a quality as to be of considerable commercial value. When such insects are found in a wild state, the silk produced by them is known as 'wild silk.' In some cases it is possible to hatch such 'worms' and rear them under artificial conditions. The silk then produced is much superior in quality to the wild variety.

The silk-worms generally referred to as 'wild' belong, for the most part, to the family *Saturniidae*, whereas the mulberry feeding moths belong to the family *Bombycidae*. For example 'tussur,' silk is obtained from species of the genus *Antheræa*—Chinese tussur from *A. pernyi*, Indan from *A. mylitta* vel *paphia*—and the tussur silk industry is an important one in the East. But another genus—*Attacus*—produces the well-known 'Eri' silk, which is used for mixing with 'tussur,' and also independently for the manufacture of woven cloths of great strength and durability. Ceylon has tried both mulberry silk and Eri; and white cocoons of *Attacus ricini* sent to Europe, have been valued at 1s. 6d. per lb.; the weight of single pierced cocoons varying from 0·3 to 0·57 gram—which would mean from 800 to 1500 cocoons to the pound.

Attacus ricini—the 'eri' or 'castor silk worm'—is the domesticated form of *A. cynthia* which is found in a wild state in Assam and the outer forested slopes of the Himalayas, and is a near relation of our own *A. hesperus*. Some account of the breeding and utilizing of the eri moth—taken from the invaluable records of the Agricu'tural Research Institute, Pusa—may therefore be of interest.

During the last two years *Attacus ricini* has been experimentally grown at Pusa, and the industry is being developed in other parts of India from seed obtained from the Institute. Eri silk has peculiarities which distinguish it from all other silks. In the first place, the worms require only castor leaves for food; mulberry is not a food-plant. In the second, the cocoon is not a closed one and is not reelable in the same way as are mulberry and tussur silk cocoons. The caterpillar in preparing the cocoon leaves one end closed only with converging loops of silk so that, while nothing can get in, the moth can push out; but the cocoon is made in layers, is not composed of a single thread, and cannot be reeled by the ordinary process. On the other hand the silk has this immense advantage, that the cocoons do not require to be 'stifled.' *i. e*, killed, to prevent the egress of the moth. In preparing mulberry and tussur silk, the cocoon is killed, since the moth in getting out so damages the structure that it cannot be reeled so well. In eri silk, this is not so; so the moth can be allowed to emerge, and the taking of life, so abhorrent to many classes in India, is not necessary.

Another feature is the number of broods. Seven or eight are obtained yearly, and, as the production of eggs is large, a big brood can be secured from a small quantity of seed, when castor is plentiful. Rearing can be done in any building; at Pusa a

grass and bamboo house has proved quite sufficient. And *A. ricini* is completely domesticated in the sense that it will not run wild and become a pest; the whole life of the insect is passed in captivity, and the moths do not attempt to leave the rearing house. Lastly, the silk cocoons can be utilised just as cotton is, but yield a cloth far more durable and lasting. The cocoons are boiled and then spun in the ordinary way that cotton is. The thread produced can be woven like cotton, and the cloth, or the cocoons, take dye easily. In fact the dyeing is easier than with cotton; and with the indigenous and the synthetic (aniline) dyes a great range of colours can be produced.

The insect lives, as other insects do, in four stages; the moth lays eggs, which hatch to caterpillars—the so-called "worms"—which feed on the leaf of the castor oil plant; the worms moult four times, at each moult increasing in size; when full grown they retire into hiding and spin the cocoon. So far as our experience with *A. hesperus* has gone, the common Duranta (*D. Plumierii*) is a favourite food plant, and the cocoon is spun on the under surface of a leaf, which on dying forms a protection to the insect; the leaf being invariably placed on the 'weather side' of the cocoon. It is, however, easily detached, and need offer no obstacle to the handling of the silk. In this snug case the larvae change to the pupa state, in which they lie motionless and require no food; from this the moth—which is of either sex—emerges; the sexes pair and the female lays eggs. The Eri moths require attention in only two stages, the worm and the moth. The eggs are placed on a tray and left till they hatch. In dry weather they are covered with a damp cloth. When the first one is seen to hatch, they are covered with the youngest and smallest leaves of castor, spread out over them. They crawl up the leaves and feed, and can then be removed attached to the fine leaves and put in a clean tray. At intervals moults occur, the worms ceasing to feed and throwing off their skin. This is the time when, if any are weak, they die. The full grown larvae, when ready to spin, become restless and move about; they are then placed in baskets filled with any convenient dry packing material, *e.g.* the finely shredded wood used in packing delicate goods, wood-shavings, torn paper, dry straw or dry leaves. Into this they crawl and spin cocoons, first making a foundation, then spinning the regular cocoon inside. This occupies about three days. The cocoons are left for at least a week, and are then picked out by hand and laid out before the moths emerge. The adult insects come out with crumpled wings, which gradually spread out They void a large drop of staining fluid, so it is advisable to let them crawl up off the cocoons—for which a special (but very simple) 'emergence tray' may be found useful, The moths are then collected into baskets, where they couple.

After twenty-four hours the couples are separated, and the females put in other baskets to lay eggs; after which they die. The moths lay, as a rule, from 200 to 300 eggs each. Starting in June with 1,000 eggs, one would have 900 moths by August 15th, yielding about 80,000 eggs, which would give a very large brood The rate of increase is so large and rapid that one can easily start afresh every season.

In rearing, very few appliances are required. A large supply of trays, made of split bamboo or similar material, is necessary, some with fine mesh, some with coarse, open mesh: the former may be the smaller. One may keep the largest worms in large rectangular trays of any size up to four feet by three feet. For the cocoons and moths, baskets are required and a supply of material for the worms to spin in. As for food, an acre of castor, not too heavily picked, should yield 4,000 to 6,000 lbs. of leaf; and it takes 75 lbs. of castor leaf to feed the number of worms, large or small, which produce one lb. of cocoons. Of good cocoons about 1,250 go to a lb.; of small ones, as many as 2, 00. A pound of cocoons, after treatment, yields about twelve ounces of thread (75 per cent).

The colour of the cocoons—which may be brown or white—is immaterial; for by boiling the brown colour is dissolved out.

The cocoons are boiled in water containing either castor ash—which contains about 28 % of potassium carbonate—or soda. The gum on the thread is thus dissolved and the cocoon becomes soft. In using soda, one takes for each pound of silk a quarter of a pound of soda, and boils for three quarters of an hour; and this is the best treatment. The cocoons are then washed and are ready for spinning—which may be done either from the wet cocoon or the dry one. The former gives a finer, closer thread of dirty colour, the latter a white, fluffy thread less suited to fine weaving. An improvement in spinning has been effected by the use of a new machine, in which the spinning is continuous by means of the 'flying needle' and is done on to bobbins direct. This machine has been worked out at Pusa and is in use there. Even by the usual methods, one can produce good durable cloth, of a white or écru colour, either fine or thick, with great durability and wearing qualities. The silk has not the appearance of the fine reeled silks; it has not the gloss and the sheen; but is best as described being the familiar "Assam Silk."

Wild cocoons of *A. hesperus* in Georgetown occasionally appear to be badly parasitised: a batch of ten gave us only two moths. Two small flies emerged from one cocoon, but un-

fortunately escaped and were not identified. In Assam a parasitic fly attacks the larvae of *A. ricini*, and great care is taken that this pest shall not be introdnced into Pusa. In Guiana too, 'old witch' birds, *(Crotophaga major).* which seem quite fearless of the most forbidding caterpillars—and gaudily coloured larvae are often distasteful to birds—have been known to raid a tree covered with a promising brood of silk worms, and to clear them all off in the space of a few hours.

In Behar, the cost of producing the cocoons of Eri silk, spinning the thread and weaving the cloth, totals up to much less than the market value of the cloth, though full wages are paid to the rearers and spinners. Where the business is done by whole families, including women and children in their leisure time when field work is not pressing, it represents a valuable minor industry.

Notes.

Raw Material. Agriculturists may be manufactured from unpromising material enough, provided perseverance and patience be employed ; but (if we may judge from a note in "The Colonial Office Journal,") the Papuan native at present represents perhaps the roughest of the rough. "The habit of fighting," we read, "is still strong. As an instance of this, the Administrator tells a curious story of how he tried two men for throwing spears at the police ; they pleaded guilty, and he explained to them through interpreters, that they must never do it again. Thereupon they asked that they might be hanged, and when asked their reason said that their only pleasure in life was throwing spears at the police, and if this was denied them they did not wish to live." Yet "there are signs that when greater security to life is guaranteed these natives will settle down to agricultural pursuits. Experience has shewn that this type of native (graphically described elsewhere in the note as 'a murderous lot and of repulsive appearance') may be brought to a state of comparative civilisation without any great difficulty by the exercise of tact and patience As, for instance, was the case with the Red Creek natives in the Northern Division, who from apparently tameless savages, have now developed into a race of market gardeners and carriers." As an example of the eternal springing of hope in matters agricultural, this extract would be hard to beat.

Specimen Rices from India. In May, 1908, the Director of Science and Agriculture asked that application should be made to the Government of India for supplies of seed paddy of the best varieties of rice cultivated in the great Dependency, and these specimen parcels—each 2 lbs. in weight —duly arrived in September last. The Inspector General of Agriculture in India seems to have been at great pains to get together and forward a really representative collection, for, in all, fifty-six kinds were sent and these hailed from all over India. E. Bengal and Assam, the Central Provinces, the United Provinces, the Bombay Presidency, Madras, and Burma-Rangoon, were all laid under cultivation, and there can be little doubt that we have now everything requisite for a comprehensive series of experiments which should give valuable comparative results. On their arrival, the varieties of paddy were carefully inspected by officers of the Department of Science and Agriculture; and it is gratifying to note that many of the kinds representative of India were poorer than types already here, and that some were much inferior. The samples have been classified locally as "Barley," "Long grained," "Intermediate" (between barley and long grained), "Red" and small "Bird-seed." Of these, seven of the first, three of the second, one of the third, two of the fourth, and two of the fifth—fifteen in all—were selected as the best for local trial, and it has been decided to plant these out immediately. Small samples will be kept for reference, while the others will be retained as examples of Indian varieties of rice. Two black kinds have been selected for the hybridization experiments. It is noteworthy that all the Burma-Rangoon paddies were considered worthy of selection by the Department.

The Value of Spraying for Scale. In the last number of the *Journal*, it was stated that spraying for the reduction of scale insects was being commenced on the lime plantation at Agatash. During a visit made by the Director and other officers of the Department of Science and Agriculture in April last, a fair number of the young limes were found to be affected by scale insects. Spraying with rosin compound was strongly recommended, and two knapsack sprayers were obtained from England. The result was most satisfactory, for practically all the scales were killed after the second spraying. This operation has now been made part of the estate routine, and whenever scales are observed on the lime trees spraying is immediately resorted to. When the plantation was visited by the Agricultural Superintendent in September, no scales could be found, and so satisfied have the management of the estate been with the results of spraying that they are considering the advisability of ordering

more sprayers in order to be able to cope with any outbreak that may occur in their rapidly increasing area. The scales dealt with were:—the mussel scale (*Mytilaspis citri*), the orange snow scale (*Chionaspis citri*), the West Indian red scale, (*Aspidiotus articulatus*), and a species of *Lecanium*, probably *Lecanium viride*. The spray compound used was that given on page 16 of the last number of the *Journal* and it may be repeated—as follows:—Mix 4 lb. of powdered rosin and 3 lb. of powdered washing soda in 1 gallon of water. Boil, and when all is dissolved make up to 5 gallons. Boil the mixture until it becomes of a clear brownish colour. This may be called the stock solution. For use, dilute part of this stock solution with 6 parts of water. The materials cost about 96 cents per 100 gallons. In time, no doubt, a much greater amount of spraying will be done in this colony than is practised at present. The above success will surely encourage others, and a large number of spray machines will be imported; and it is confidently hoped that the time is not far distant when large numbers of our economic and ornamental plants will be saved from the ravages of the insect pests and fungus diseases now so rife and so unchecked.

Practical Entomology. Examples of the successful practical application of entomology to agriculture accumulate, in spite of the doubt which has been thrown on some of the too enthusiastically advertised results of the American school. In South Africa figs are grown; but hitherto with little success. Why? Entomology supplies the answer. The relation of the Calimyrna variety—the true "Smyrna" drying fig of commerce—to certain small wasps of the group of the *Chalcididae* is one of the most remarkable in all Natural History. Looking at a fig which has been cut open lengthwise, it is observed that it is not a single flower but rather a whole collection of flowers enclosed in an urn or pear-shaped receptacle. The orifice of the urn is very small, and is further straitened by the presence of small leafy scales. The flowers, which are very simple in structure, almost fill the entire cavity. They are of two kinds, male and female; and of the female flowers there are also two kinds—the one normal, with long styles, and the other with short styles and aborted stigmas. In the "caprifig" individuals of the common *Ficus carica* cultivated in Southern Europe, all or most of the female flowers below the male ones are transformed into "gall-flowers." These are produced from modified female flowers—those with short styles and abortive stigmas—in the following manner. The small wasp already referred to—*Blastophaga grossorum*—lives upon the cultivated fig; passes into the cavity of the "urn" through the orifice; and there sinks its ovipositor

right down the style-canal of the flower and deposits an egg close to the nucellus of the ovule. The white larva developed from the egg increases rapidly in size and soon fills the entire ovary, whilst the ovule perishes. The ovary has now become a gall. When the wasps are mature, they forsake the galls. The wingless males are the first to emerge; the females remain a little longer in their galls and are there fertilized by the males. Afterwards they come out, crawling up to the mouth of the "urn"; and in doing so they come into contact with the pollen of the male flowers and get dusted all over the body—head, thorax, abdomen, legs, and wings. On emergence, they at once visit neighbouring inflorescences, and among them the "urns" of "edible" individuals (which contain normal female flowers only), enter them and devote themselves to laying eggs. In the process they are necessarily brought into contact with the stigmas of the female flowers. The wasps are still powdered over with the pollen from their birthplace, and it is now brushed off on the stigmas, which are thus pollinated from another inflorescence. Let us see how practical application is made of these interesting facts. "Astonishing success," writes the Government Entomologist of the Cape of Good Hope, in his Report for 1908, "has been achieved in multiplying the Blastophaga (*B. grossorum*) the very tiny wasp-like insect necessary for the natural pollination of edible figs and indispensable for the commercial production of the Calimyrna variety......Emergence of the wasps began about October 1, and many thousands of the "profichi" or caprifigs then forming, practically every one in the block of about fifty small trees was successfully entered by them. This crop of caprifigs furnishes the pollen for the edible figs, and the insects carry it to the latter...At the time of writing, it is evident that the pollination or 'caprification' of the Calimyrna, and also of the several other recently introduced varieties requiring the function, has been a most pronounced success. In other years the fruit of the several varieties has, by this date, withered and dropped without becoming edible; that of this season, through the stimulus of fertilization, is remaining on and is swelling rapidly. The production in this country of the finest quality of dried figs should now be practicable. The necessary factors seem all present—soil, climate, proper varieties of figs, the caprifig trees to furnish the pollen and insects to transfer the pollen."

Rubber from Banana Plants. As we go to press a copy of *The India-rubber Journal* reaches us, and in it a comment on Mr. G. C. Benson's "banana rubber" catches our eye. We may quote from it without prejudice. "The idea is not entirely a new one. Some years ago—in July, 1898, to be precise—Otto Zürcher, of Kingston, Jamaica, took out a patent for an

improved process for the extraction of india-rubber. According to this invention, bananas and the fruit of other Musæae are cleaned with waterjet and then cut from the stems when about half-ripe. They are then cut crosswise, and the surrounding leaves, skin and stem are separated. The inner portions are drained of liquid, and afterwards extracted by placing them radially in a centrifugal machine, or with turpentine or other solvent in a vacuum. The outer parts are cut and crushed and extracted similarly. India-rubber separates from the liquids produced, on standing, or by treatment in a centrifugal machine. India-rubber may be obtained from parts of other plants by the same process....From our knowledge of the anatomy of these plants (concludes *The India-rubber Journal*), we do not believe the idea is worth going on with. Sections through various parts of the banana plant, for microscopic examination, can be seen by arrangement at the offices of *The India-rubber Journal*. We think that a study of the latex channels, as revealed in the sections referred to, will not lead to any display of enthusiasm on the part of the investigator."

A Lost Orchid Rediscovered.

In 1905 the "Lost Orchid"—*Cypripedium Fairrieanum*—was rediscovered by an Englishman, and he, with Mr. S. P Chatterji, the well-known florist and nurseryman of Calcutta, have the secret of its natural habitat between them. They had, in the year mentioned, a fine stock of the plants, and became entitled to the reward of £2,000 (says "Indian Gardening") offered by a certain London firm of plant merchants to anyone who would rediscover the "Lost Orchid." The locality where this orchid was found remains a profound secret,—at least, such was the statement made at the time—but, suffice it to say, it was *not* found in the Garo Hills, its supposed natural habitat. There was no doubt at all as to the identity of the plant, as it was submi ted to Dr. Prain, then Director of the Royal Botanic Gardens, Calcutta. This was probably the most important and sensational announcement that the horticultural and botanical world has received for many years. The plant was lost to the world in 1876 and, until its rediscovery, may be said to have been practically extinct in Europe.

The Question of a Banana Industry.

During the past three months, the question of the possibility of establishing a banana industry in this colony has been engaging attention in many quarters. Correspondence has been carried on through the medium of the local press, and several public meetings have been held in different villages, particularly along the East Coast.

This is not the first time such a question has been raised. In 1888, the possibilities of establishing a banana industry were considered, and in May of that year a resolution was agreed to in the Combined Court recommending a subsidy to the Bay State Fruit Company, to be paid over a period of five years, to establish a line of ships for the transport of bananas from this colony to American markets. Nothing, however, came of this suggested enterprise, and in March, 1889, a petition was passed in favour of another American company. A Commission was appointed to carefully consider the matter, and it was recommended in a preliminary report that there should be placed upon the Estimates for 1889-90, $10,000 to defray the preliminary expense of encouraging the cultivation of bananas suitable for export and that as soon as the Government should be satisfied that the Fruit and Banana Industry could be encouraged a subsidy for five years of $25,000 should be granted for transportation.

A sum of $10,000 was accordingly placed upon the estimates but was not expended, as those in the United States of America supposed to be interested in the movement took no further steps to start the industry on business-like lines, other than by supplying to the colony 10,000 suckers of the Jamaican variety of banana Part of these were planted in the Experimental Fields at the Botanic Gardens and an area of somewhat over two acres was kept under cultivation with them for three or four years. By order of the late Quintin Hogg several acres were planted with the suckers on the fields of La Penitence, to the south of the Experimental Fields, on which they grew in a sickly manner for a few years and eventually died out.

In the final Report of the commission in 1895, it was stated—

(1) that at that time there were no regular cultivations of bananas and there were but few bananas grown on plantain farms in an irregular way;

(2) that an average price of less than 25 cents per bunch would not pay the growers, and

(3) that no supply of bananas for an export trade then existed,

The commission further expressed the belief that the fruit could be profitably cultivated to meet an export trade of 10,000 bunches a fortnight if suitable arrangements could be made.

In 1902, Professor Spawn came to the colony in connection with banana coffee. Great interest was created in his suggestions, but nothing came of them.

In 1907, the Government made an effort to ascertain whether an export trade in bananas could be established on the lines of the arrangement made between the Government of Dutch Guiana and the United Fruit Company. All the attorneys and managers of sugar plantations and village councils were circularized, but of the forty-six replies received only seven were favourable, and therefore it was not considered possible to make suitable arrangements without an assurance that a large enough area would be cultivated to guarantee a sufficient number of bunches of bananas being produced for export.

The present movement has originated with the people, who being advised of the advances that are being made in Surinam with the banana industry, and of the fact that the line of steamers also calls at this colony, are of the opinion that arrangements could possibly be made with this line, or some other, to take bananas from this colony if they were produced in sufficient quantity. It is, therefore, thought that it might be of advantage to give a brief review of the present business in bananas, to indicate what points would have to be specially considered in connection with the establishment of a banana industry in this colony, and to give hints in regard to cultural and other matters that would be of value to the growers.

THE WORLD'S TRADE IN BANANAS.

I have not complete figures available for the whole of the banana-producing countries, but a consideration of those that are here enumerated will indicate, in brief, the extent of the world's trade in bananas :—

Jamaica :—During the past three years, an average of 16,500,000 bunches have been exported, distributed as follows :—15,000,000 bunches to the United States, and 1,500,000 bunches to England.

Costa Rica :—In 1908, some 10,000,000 bunches were exported, but it was estimated that fully 2,000,000 bunches were lost through winds and storms. Some 7,000,000 bunches were exported to the United States, and 3,000,000 bunches to European markets, in which a decided effort is being made to introduce Costa Rica bananas.

Honduras:—In 1908, 4,300,000 bunches were exported as compared with over 5,000,000 bunches in 1906 and 1907. Further exploitation is being pushed forward.

Columbia:—Some 2,250,000 bunches were exported in 1908, and it is estimated that within five years not less than 5,000,000 bunches will be exported annually. There has been remarkable progress of late in this country. The first shipment of bananas was made in 1891 and for the first 13 years the exports never reached 500,000 bunches in any one year. In 1904, 780,000 bunches were shipped, and since then the exports have rapidly increased.

Nicaragua:—In 1908, 1,250,000 bunches were exported. Large areas have recently been granted for the growing of bananas and the exports should rapidly increase.

Other Countries:—Guatemala, 700,000 bunches in 1908 San Domingo, 450,000 bunches; Cuba, about 500,000 bunches; British Honduras, 400,000 bunches; and smaller quantities from Panama and Surinam, while the export from the Canary Islands of the dwarf banana was nearly 2,500,000 crates holding roughly 3,000,000 bunches of bananas.

The total trade to America in 1908 was about 32,250,000 bunches and the trade to English and European markets was about 4,000,000 bunches of the Gros Michel or Jamaican variety and 3,000,000 bunches of the dwarf or Chinese kind.

Points to be Considered.

The first question to be asked is whether the soil is suitable and what area would be available within easy reach of the port of shipment. There are many circumstances that affect this issue. The cultivation of bananas is now carried on in a large number of countries, the prices are gradually falling, and only the best quality of fruit is now readily acceptable on the markets. In Surinam, 36 hours is given to cut and deliver fruit, and therefore it is essential for an export trade that the land on which bananas are cultivated be within near distance of the port of shipment. For an export trade of say 20,000 bunches of bananas a week, it would be necessary to have at least 5,000 acres under cultivation. In fact, the United Fruit Company in their Surinam contract stipulated that over 7,000 acres should be planted within three years of signing the contract, to ensure a minimum quantity of 20,000 bunches per week. Poor land or worn-out cane land will not produce first class fruit, and therefore it is necessary at the beginning that the land should be of good quality. A large amount of our coast-lands would not be

suitable for the successful cultivation of bananas, but it is probable, if means of transport to the seaboard were readily available, that much of the back lands would suit admirably. A good deal of the land on the lower parts of the rivers should also grow good crops of bananas, but cultivation could not be practised too far away from the port of shipment or otherwise the fruit could not be cut and delivered in the specified time.

The next question to be given careful consideration is the available labour supply. In Surinam, it has been found that it is necessary to have three labourers for every five acres of banana cultivation, but there are times when a larger number are required. It would most probably be found, that 5,000 acres under bananas would afford sufficient continuous employment for 3,000 people.

Co-operation is essential for a successful banana industry. It would be necessary that all the bananas be delivered at the port of shipment within the 12 hours immediately before the ships are scheduled to sail, and the previous 24 hours would be given for cutting, packing, and transporting to the port. A very efficient organization is required to accomplish all this work within such a limited space of time, and unless everything works smoothly, a considerable loss of fruit will result. In fact the banana industry is now run on such modern business methods that it would be necessary for a considerable area of bananas to be planted in the same district under a single Association, in order that management expenses may be reduced, and in order that transport and shipment could be economically carried out. It is no longer possible for the small man to cultivate a few acres and to market his fruit, unless it is through some central association, and furthermore steamship companies cannot be induced to put on a line of steamers unless a sufficiently large number of bunches is guaranteed, and sufficiently good security is forthcoming. The banana industry of Jamaica is now chiefly in the hands of large growers, while the cultivations in Central America are under the control of large companies that have many thousands of acres under single managements.

In Surinam, the nucleus of the industry is held by the Government itself. There are now about 5,000 acres under banana cultivation in that country, and practically none are cultivated by 'small growers;' The greater part of these bananas are at present grown upon lands that were abandoned from sugar-cane cultivation some 50 or 60 years ago, and upon lands that have in recent years been abandoned from cacao cultivation by reason of the witch-broom disease.

Finally, means for transport must be obtained. It depends of course as to what market it is intended to ship to as to what variety would be the most suitable to grow. The American market *will* only take the Gros Michel or Jamaican banana, while the English market favours the dwarf or Chinese variety.

The Jamaica and Surinam trade, as also the greater part of the Central American, is in the hands of the United Fruit Company. They may be said to control the whole of the market in the Gros Michel or Jamaican banana. It must, therefore be assumed that this company would have to be approached if a successful trade were hoped to be built up with America.

The United Fruit Company has a most efficient organization in all the banana-producing countries with which it is connected, and is, at present, rather inclined to favour extension of operations in the fields in which it is thoroughly established than to look for new fields to work up, unless exceptionally favourable terms are offered. Any business man, on carefully examining the Surinam contract must note that the Company requires particularly favourable conditions. The whole of the organization was left to the Surinam Government, who had to guarantee that a certain area would be planted within a certain period, and that the shipments would reach a certain size. It is more than probable that similar conditions would be required in the case of any similar contract for bananas from this Colony, and it would therefore be necessary for a considerable area to be guaranteed to be planted in bananas before such a contract could be entered upon. For the American market it would seem that only the United Fruit Company could be approached, as other companies could not compete with such a monopoly as the United Fruit Company holds.

Could bananas be shipped satisfactorily to England? They are being shipped in large quantities from Jamaica and Costa Rica, but the dwarf or Chinese variety from the Canaries still commands universal favour. An examination of the few details of the Barbados experiment would indicate that the Chinese variety of bananas can be shipped satisfactorily in cold storage, if packed in cotton wool in crates. A direct steamship service capable of accomplishing the journey in 10 or 12 days, would be necessary, and the rates of freight would have to be sufficiently low to afford a reasonable margin of profit to the growers. The rates of freight from the Canaries during 1907 ranged from 1s. to 1s. 3d. per crate, but this was considered high and caused a certain amount of dissatisfaction among the growers.

In conclusion, the methods of cultivation in vogue in this colony would be entirely unsuited for the successful cultivation of bananas for an export trade, and a careful consideration of the Jamaica methods, a brief account of which is appended herewith, and of the leaflet lately issued by the Board of Agriculture is strongly recommended. The opinion formed by the Department of Science and Agriculture is that, supposing a sufficiently large area were put in banana cultivation under the control of a strong organization to form a nucleus for the industry, the smaller growers could, with careful attention to cultivation, etc., be encouraged to plant bananas and would make a fair profit. Without such a nucleus, however, the smaller growers could not themselves establish a successful industry.

THE BARBADOS EXPERIMENT.

In May 1902, the Superintendent of the Royal Mail Steam Packet Company at Barbados, invited the Imperial Commissioner of Agriculture to test a new banana carrier by which it was proposed to carry bananas from the West Indies to England. It was found that the dwarf or Chinese bananas could satisfactorily be carried in the ordinary hold during the cold season, but that in the hot season the shipments arrived in an over-ripe condition. Hall's system of cold storage was therefore installed in some of the ships of this line, and larger shipments of bananas were made. In 1902, 18 bunches of bananas were shipped, in 1903 6,691 bunches, in 1904 15,326 bunches, in 1905 28,008 bunches were shipped up to October 5th. In July of 1905, however, shipments of bananas from Trinidad occupied a considerable portion of the cold storage holds, and the Barbados bananas had to be put in other parts of the vessel, with the result that the 10,439 bunches shipped from October 5th, 1905 to March 31st, 1906 netted in England only about 2d. per bunch. This meant a loss to the planters of nearly one shilling per bunch in freight and other expenses alone, and consequently growers discontinued to ship.

The Barbados bananas when they arrived in England in good condition commanded a ready sale and netted to the planters from 2s. 3d. to 2s. 6d. per bunch, and as the cost of crates, packing, etc. amounted to about 1s. 3d. per bunch, the net profits on good shipments worked out at about one shilling to 1s. 3d. per bunch. Without assured space in cold-storage holds it was found impossible to ship the dwarf or Chinese variety successfully.

Jamaica Methods of Cultivation.

The method of cultivating bananas in Jamaica differs considerably from that practised in this colony and it is thought that a brief description of the former practice may not be without interest :—

If forest land is brought under banana cultivation some planters simply cut and burn, leaving the stumps to decay. Others, however, prefer to stump the land as soon as possible, in order that the suckers may be put in regularly and so that ploughing may be carried out much earlier than if the stumps were not removed. Virgin land is not ploughed however for the first crop. Old cane land or pasture is throughly ploughed to at least nine inches deep. This ploughing is generally done in January. The land is then carefully harrowed. It is allowed to lie fallow until the beginning of March , when it is cross ploughed and harrowed. The fields are then lined ready for planting, which is usually done in the end of March or the beginning of April. Hill lands cannot be ploughed. They are, therefore, forked before being lined for planting.

Great care is taken with the drainage and irrigation systems, as it is absolutely essential for a successful banana cultivation to have good drainage, and the irrigation system must be laid out so that the smaller water channels may be easily changed as occasion arises.

Planting.

Planting is generally done in Jamaica from January to April in order to catch the high prices of the American market. Where irrigation is not possible March and April are recognised as the planting months, so that the suckers may be ready to benefit by the rains that commence in May.

The usual distance for planting on the south side of the island is 14 feet x 14 feet, while 15 feet x 15 feet is generally recognised as being most suitable on the southern side. The distance in the hills is usually 12 feet x 12 feet. Experiments have been tried with planting 15 feet x 10 feet or 15 feet x 8 feet. with varied results, while 8 feet x 8 feet and 10 feet x 10 feet are not uncommon in some of the very hot flat lands, in order to shade the ground as soon as possible after planting. The general concensus of opinion throughout the island favours the wider planting, as the bunches are of better size and quality. The holes are usually dug from 2 feet to 3 feet square and vary in depth from 1 foot to 2½ feet. The deeper holes are generally advocated where labour is plentiful.

Seed-Suckers.

The suckers which would be selected for planting are not the same as those that would be chosen in this colony, and the method of treatment is totally different. Suckers for planting purposes are suckers that have not been cut back, or in other words "sword-suckers,"—as indicated by their first leaves being very narrow—which have been allowed to grow to about eight or ten feet in height and which have large bulbs at their base. No small suckers, such as we choose in this colony, are taken. In preparing their suckers for planting, the Jamaicans cut down those selected to within about six inches of the ground and then dig out the bulbs. All the old roots are then trimmed off and the bulb is planted so that the eyes are at least three or four inches below the level of the ground. From this bulb, three or four suckers will spring up. The strongest one is selected, and all the others are pruned off until June when one or two suckers are left, and then again all others are pruned off until October when there is again left either one or two, and finally another is left the following February. It is calculated that the first suckers should fruit in the following March, the June suckersin May, the October ones in February or March twelve months, and the February one in May or June twelve months. This system for timing is the outcome of long experience and could not be adopted in this colony without modification, on account of differences in climatic and rainfall conditions.

Irrigation and After-cultivation.

When the suckers are first planted the smaller water-channels are put close to the suckers, so that they may get the benefit of all the water, but after they have become well established it is the usual practice to run the water channels in the centre of the rows, for the bananas benefit more thereby, and the stools do not produce such a large number of suckers as if the water were actually around the stools.

When the suckers have become established, shallow ploughing is generally carried on until November once every eight or ten weeks, one ploughing with the rows and the next across the rows. Each ploughing is followed by a light harrowing to break down the soil and to keep the land clear of weeds. After November, ploughing is generally stopped until after the main crop for the American market has been picked. During this period, as also during such rainy weather that the plough cannot be used, the weeds are kept down with a cutlass or hoe.

In those parts of the island where ploughing is not generally practised, or on those lands where ploughing is impossible,

constant forkings are given during the earlier growth of the suckers, while during the fruiting period all weeds are kept down with the cutlass. Very particular attention is given to cultivation in order that the maximum quantity of large bunches may be obtained. It is useless to expect good results unless good tillage is given frequently ; for it has been found that bananas cannot be made to yield satisfactory profits if cultivation is carried out " on the cheap."

In some districts, artificial manures are applied to bananas, but the most satisfactory results have been obtained from pen manure and other humus-forming substances. All the the old banana stems, trash, etc., are cut up and ploughed in with beneficial results. Their application improves the general texture of the soil and makes it drain more readily.

Removal of Leaves and Suckers.

As the leaves decay, they hang down around the stem. It is the usual practice to allow a few of these to remain as they protect the stem from the sun, but if they become numerous some of them are removed, or otherwise they tend to cause the stem to shoot up rapidly and to become weak and slender, incapable of bearing a full bunch of fruits. In no case are hanging leaves allowed to trail upon the ground. Such leaves are pruned away.

All suckers that are not intended to yield fruit are carefully removed. They are usually pruned away from their parent bulbs when they are quite young, for if they are allowed to grow large they drain food-materials from the main stems, and small bunches result. In all cases every effort is made to cut the suckers away from the parent bulbs or otherwise they rapidly spring again.

Picking the Fruit.

The picking of the fruit is done by the hundred stems. Each plant is partly cut through some five or six feet from the ground, so that the top of the plant, with the bunch, slowly falls over. The bunch is caught so that it does not get bruised and is then severed and handed to women, who carry it to a certain place in the plantation. Here a book-keeper enters it up as being a bunch of a certain size, or discards it as being unsuited for export.

The bunches are then wrapped in trash, and handed into a cart, where they are carefully packed for transport either to the sea-board for shipment to Kingston in punts or to one of the numer ous sheds along the railway line for receipt by the banana

trains that run to the wharf and unload direct into the steamships that carry fruit to either the American or the English markets.

In picking the bunches in the field it was formerly the usual custom for men to work singly, but now greater care is being taken on some of the estates. They work in pairs, the one to cut the bunch down and the other to catch it and hand it to the women who carry the bananas to be noted by the book-keepers.

CUTTING DOWN OLD STEMS.

After the bunch is cut off, the head of the plant is completely severed from the stem some distance above where it was partly cut through at the time of picking. The top part of the stem and the leaves that have been cut off are then chopped up and spread over the land ready to be ploughed in, while the lower part of the stem is left standing to decay. It is generally held that a fair task for a man is to cut and chop about 100 stems per diem.

REPLANTING.

In a banana plantation some planting is done every year. It depends largely upon the nature of the soil, and upon the locality as to how long bananas may be ratooned. In some districts replanting is done every three years, while in others six years is not considered too long for ratooning. A field to be thrown out is planted in vigorous-growing leguminous climbers such as the velvet bean, etc. These plants climb over the banana plants and soon kill them out. They are then all cut down, cut into pieces, and ploughed in. After a time, the field is replanted, the new rows alternating, if possible, with the places where the old ones were. There is a growing tendency throughout the whole island to reduce the period of ratooning and to replant every two or three years, as it is found that by so doing the crops may be better timed for the American market, as after first ratoons the plants fruit somewhat irregularly.

YIELDS.

The general yield for the whole island is about 280 payable bunches per acre per year, but on well cultivated lands 325 to 330 bunches are considered by most planters as being a fair average. As a rule, it is held that about 65 per cent. of plants should yield bunches, and at least 85 per cent. of first ratoons.

Yields depend largely upon locality, soil, irrigation, cultivation, etc., and vary considerably throughout the island, but it is generally recognised that the best results can be obtained only by intensive cultivation.

COST OF CULTIVATION.

The cost of cultivation varies slightly in the different districts, but it has been found that the average cost of preparing the land, after-cultivation, interest and depreciation on capital, outlay for buildings, roads, etc., would amount in an irrigated district to from £12 to £15 per acre during the first year, and an annual expenditure of from £10 to £12 afterwards. For non-irrigated lands the cost would be from £9 to £12 during the first year and £8 to £10 afterwards. These estimates assume that suckers are readily available and do not have to be bought.

JAMAICA PRICES.

The prices given by the United Fruit Company per 100 bunches to those who contracted to supply a certain number all the year round were in 1901, as follows :—

January £6, February £7 10s., March £10, April £12 10s., May £12 10s., June £11 10s., July £7 10s., August £5 10s., September £6, Octboer £6 5s., November £6 5s., December £5 10s.

In 1906, the contract prices were :—

January £5, February £6 5s., March £10, April £12 10s., May £12 10s., June £11, July £8, August £6, September, October, November, December £5 per 100 bunches.

I have no figures later than 1906, but there has been a large increase in banana production in Central America and the ruling prices are now somewhat less than they were in that year.

F. A. STOCKDALE.

APPENDIX I.

THE SURINAM CONTRACT.

The following is the text of the contract between the Surinam Government and the United Fruit Company :—

1. The Government agrees to sell to the Company all the merchantable bananas which shall be produced for export under and according to an Ordinance (B. G. No. 53) and agrees to sell to no one else for export directly or indirectly, any bananas. The Government is free to do with the bananas which are not acceptable for the Company whatever it chooses; except to export in natural state.

2. The Government agrees to do all in its power to influence all planters to grow bananas and sell them to the Company on the same terms and conditions as those which are directly under Government control.

3. The Company agrees to buy and pay for all the merchantable bananas on the terms and for the prices hereinafter named, up to a total quantity per year of 1,500,000 stems and shall have the option of taking any and all the bananas that may be produced in excess of this quantity and on the same terms and conditions.

4. To insure the quantity that shall be produced during the term of this Contract, the Government binds itself to have about 1,000 hectares (2,470 acres) planted each year before the first day of April of the years 1907, 1908, and 1909, or the whole quantity may be planted during the first and second years.

5. The first shipment under this agreement shall be between the first day of February and the first day of April, 1908, on a date to be mutually determined between the Government of Surinam and the Company.

6. The Company shall not be obliged to take bananas from Surinam under this contract unless the quantity shall have reached, or be the amount of 20,000 stems per ship.

7. The Government shall each week on Friday morning give an estimate to the Company's representatve, or at his domicile at Paramaribo, of the quantity of stems that may be expected for the second week thereafter, in order that the Company m provide ships for the transport of the bananas for that week.

8. Should the amount estimated by the Government in any week fall short of 20,000 stems, the Company shall not pay full prices for such cargoes, bu 5 per cent. per count bunch less than the price hereafter provided in this contractt

It is mutually understood that when the estimated quantity at any one time is not sufficient to load two of the ships provided in this service but too much for one, the Company is not obliged to give orders that week for a larger quantity than can be carried by one of these ships, but the Company shall endeavour to arrange to increase its tonnage for the succeeding week so as to save as nearly as possible any loss to the planters.

It is understood that the parties to this contract shall mutually aid each other as much as possible in carrying out this contract,

9. As soon as shipments are begun under this contract, the Company agrees to take the bananas once every two weeks provided the quantity equals 20,000 stems per shipment and as much oftener as the quantity of bananas will justify.

When the quantity per week equals 20,000 stems the Company will take the bananas once every week.

10 The Company agrees to give notice in such manner to the Inspector of Agriculture or at his domicile at Paramaribo that the planters shall have at least thirty-six hours in which to cut and deliver the bananas, it being the inten-

28 MAY 1930

tion that the loading shall begin at least twelve hours before the termination of the thirty-six hours.

If Notice is given between six o'clock in the evening and six o'clock in the morning, the term of thirty-six hours shall begin to count from six o'clock in the morning; if notice is given at other time the notice shall begin to count two hours after it is given.

The Company shall not be under any obligation to receive fruit which arrives after the expiration of the time stated for the sailing of the ship.

11. If there is no ship at the time mentioned for the sailing, the delivery in that case shall be done to the representative of the Company, or in his absence to an officer appointed by the Government at a reasonable place, in which case the bananas shall be at the responsibility and peril of the Company immediately after the delivery to that officer.

12. All bananas ordered by the Company under this contract shall be delivered by the Government at the side of the ships which the Company may provide and each stem handed by the boatman of the Government to the men of the ship; in other words shall be delivered on the rail of the ship or at the sideports of the ship as may be preferred by the Company.

The bananas shall be classified and selected on board the ship by receivers or selectors provided by the Company and a receipt given to the representative of the Government who shall be present for each boat or lighter load of bananas received.

13. The bananas shall be classified as follows :—

Stems containing nine (9) fully developed hands and above shall be considered as "Firsts"

Stems containing eight (8) fully developed hands shall be considered as "Seconds."

Stems containing seven (7) fully developed hands shall be considered as "Thirds."

Rejections shall be made by the Company's receivers or selectors of all stems of bananas which shall be scratched, bruised, broken, or otherwise injured, and of all stems which are misshapen, improperly developed, as short fingered, twisted, too thin, too full, ripe, stale or otherwise unsuitable for transportation or unmerchantable. All rejected bananas shall be thrown into the river by the Company or handed back to the boatmen who deliver them, at the option of the Government.

14. The Company agrees to provide a tow-boat to assist the lighters or boats coming alongside the ships to deliver bananas, but this shall not be construed to mean that the Company shall do more than tow the boat or lighter from near by anchorage to the ship's side.

In the event of the Company not having a tow boat of their own on any or all occasions to do this work the Government agrees to provide one, charging the Company for such service the daily cost of the running expenses of the boat for the days it is in the Company's service.

15. The Company shall pay for the bananas accepted by the receivers the following prices :—

5 cents for firsts during the months of March, April, May, and June.

30 cents for firsts during November and December.

20 cents for firsts during January, February, July, August, September, and October, with the exception that during the years 1908 and 1909 the price of 35 cents also shall be paid in November and December.

Eight hands (seconds) shall be counted as two-thirds during March, April, May, June, November and December, and as halves during the other months.

Seven hands (thirds) to be counted as halves whenever taken, but it shal be optional with the Company to take them during January, February, July, August, September, and October, of any of the years of this contract.

These prices refer to American gold or its equivalent in the money o Surinam. Payment shall be made the same day the bananas are received. To determine to what month any shipment shall correspond, the date on which the order to cut was given shall be taken.

16. The name 'bananas' in this contract shall always be understood to mean the variety grown and exported by the Company from Jamaica, and this contract carries no obligation to buy any other variety or kind.

17. The Company shall have the right to anchor the ships which it provides for the export of bananas in whatever port of the river or rivers of Surinam are most convenient for the purpose and to be mutually agreed upon; and should it be necessary for the ships to go to a wharf the Government will provide suitable space at its own wharfs free, except when for business not connected with this contract.

18. During the first five years of this contract the Company shall not be required to pay any harbour dues or port charges (except pilotages) and thereafter no more han is charged to other people or companies. The Company shall be free from all its obligations arising under this contract in case the port of export or that of import should be closed on account of war, epidemic, quarantine, or any other cause whatever and so remain until normal conditions are re-established. The harbours of import to which this implies are only the United States of America, or in Europe.

19. The Government agrees to facilitate the Company in all reasonable ways in obtaining such labourers as the Company may need for their business in Surinam.

Should it occur at any time during the life of this contract that by reason of strikes or other labour troubles the Company cannot obtain labourers to load its ships, the Government shall do all in its power to make loading possible.

20. Should the Government of Surinam impose an export duty or other tax upon bananas, it is agreed that such import or taxes will be paid by the party of the first part (Government.)

21. This Contract shall begin on the 15th July, 1906, and terminate on July 1st, 1916, with the understanding that the Government is entitled to withdraw after the term of three years, provided it substitutes in its place all the companies and individuals with which it has contracted for the fulfilment of this contract in such manner as to insure to the Company the carrying out of all the provisions of this contract without detriment to the Company.

The Company shall elect domicile in Paramaribo and is submitted laws and the administration of justice of the Colony of Surinam.

22. Any disputes or differences which may occur between the parties to this contract which cannot be amicably settled between themselves shall be settled by arbitration in the customary manner in such cases, to wit;—Each party (the Government and the Company) shall each select one arbitrator.

The two shall mutually agree to a third, and the finding of the majority of the three shall be binding upon the parties to the contract. If the two arbitrators cannot agree as to a third the case shall be tried by the Court of Justice.

Any such arbitration proceedings shall take place in Paramaribo (Surinam) in accordance with the laws of Surinam, but the arbitrators need not necessarily be residents in Surinam.

23. This Contract is written in Dutch and English on the same pages for the better understanding of the parties to the agreement. The Dutch text will be the binding text, and in case of misunderstanding the English text must be taken for the explanation.

Signed—August 29th, 1906.

Amendment I.—

By mutual consent of the parties thereto the eighth paragraph of the contract of August 29th, 1906. between the Colonial Government of Surinam and the United Fruit Company is hereby amended by striking out all of the first clause of the said paragraph and substituting therefor the following :—

Should the number of stems accepted for shipment in any week fall short of 20,000 the Company shall not pay full prices for such bananas, but shall deduct an amount equivalent to ten dollars for each hundred stems or fraction thereof needed to make up 20,000 stems.

Signed—November 7th, 1906.

Amendment II.—

The fifteenth paragraph of the above contract is amended as follows:—

Beginning with the year 1909, the price of 35 cents shall be paid for bananas accepted in March, April, May, June, July and up to and including the 16th day of August, 1909.

Beginning with the year 1910, the price for all bananas accepted shall be 35 cents per count bunch for the months of March, April, May, and June, and 30 cents per count bunch for July and up to and including the 16th of August of each year until the expiration of the contract.

Beginning with the year 1909, and until the expiration of the contract, during the months or parts of the months named above, eight hand bunches shall be counted as two-thirds and sevens as halves.

The price of bananas accepted in all months or parts of months not named above, beginning with the year 1909, and until the termination of the contract shall be 20 cents per count bunch, eight hand bunches to be counted as one-half, seven as one-half when taken, being it optional with the Company to take sevens during those periods.

Signed—February 20th, 1908.

APPENDIX II

The following has recently been issued in leaflet form by the Government and has been widely distributed throughout the colony :—

CULTIVATION OF BANANAS AND PLANTAINS.

The terms 'banana' and 'plantain' were formerly used very loosely but now 'banana' or 'sweet plantain' is generally recognised to cover the sweet varieties of fruit that are used without cooking, while 'plantain' or 'cooking banana' refers to the vegetable-like fruits which must be cooked to make them palatable.

As pointed out in the Report on the agricultural work in the Botanic Gardens for the year 1890, it is only after a long and well-trained experience that the plantain can be distinguished in the field from the banana when not in flower or fruit. When in fruit, however, the case is different. In the banana, the stem or axis of the bunch grows even after the fruit has developed, and continues to do so as long as the fruit hangs. Cluster after cluster of flowers, with their bracts open and drop away and a firmly compacted mass of unopened bracts and flowers remains at the end of the stem some 2 to 3 feet below the bunch. In the plantain, the growth of the stem is arrested soon after the fruit sets and it ceases to extend more than 12 to 18 inches beyond the fruit, while the succeeding clusters of flowers and bracts open and remain attached from the bunch of fruit to the end of the stem. The only exception to this rule for the distinction of plantains from bananas when in fruit is the dwarf or Chinese banana in which, as in plantains, the abortive flowers and their bracts are constantly persistent.

VARIETIES.

The only varieties of bananas cultivated and exported on a commercial scale to markets in temperate countries are the Gros Michel or Jamaican banana, and the dwarf or Chinese variety.

The Gros Michel or Jamaican banana was known formerly as the Martinique or Pouyat, and it is also known as the Dominican variety. It is the variety cultivated in Jamaica, Surinam, Costa Rica and other Central American countries, chiefly for export to the American market. It is comparatively thick-skinned and the separate fruits lie closely to the stem. Thus it may be shipped naked.

The dwarf or Chinese variety is largely grown throughout the West Indies for home consumption, and is the variety cultivated in the Canary Islands for English and European markets, where it is sometimes known as the Canary banana. It is comparatively thin-skinned, and can only be shipped, packed in crates, in cold storage. The separate fruits on a bunch of the dwarf banana ripen irregularly, and it is thought that this character is perhaps an important drawback against the shipment of this variety for long journeys except in cold storage.

The "fig," "apple fig," and "Lady's Finger" varieties of banana which are recognised in the tropics as the most delicious of desert fruit, are too delicate for export.

The 'claret' or 'red' varieties fetch a high price in America and Europe as decorative fruits for the table, but the price is maintained by reason of the small supply. To command good prices, these varieties must reach the American and European markets in first class condition, and should therefore be shipped in crates in cold storage. The bunches of these varieties usually contain only a small number of hands and therefore a high price is necessary to make their cultivation in any way profitable.

There are also coarse varieties of bananas, such as the "horse" and "apple," hat are used locally. They are only palatable when cooked, and are made into preserves or are used in breakfast dishes.

There are three or four kinds of plantains that are generally cultivated in t colony, and they form one of the staple foods of the labouring classes. Plantains are exported only in very small quantities to the American market, mainly from Honduras.

PREPARATION OF LAND AND DRAINAGE.

Bananas and plantains do best on a deep, well-drained soil containing a fair quantity of humus. They grow particularly well in freshly cleared forest land, but in land that has been worn out by continued cultivation they may grow fairly satisfactorily, but they yield only poor crops of small bunches. They will not do well in sandy land.

Land that is to be planted should be thoroughly forked or ploughed and made up into beds 3 rods (37 feet) wide. Good drains should be dug at the sides of the beds, and the earth that is taken out should be thrown into the centres of the beds, so that they are made up higher than the sides. In districts where drainage is not particularly good, cross drains or bed-drills should be dug at regular intervals across the beds. Good drainage is absolutely essential for bananas.

After forking the beds and digging the drains, the land should be allowed to lie fallow for a month or two, and then the beds should be weeded and broken down with the hoe. The beds should, at the same time, be lined 3 rows to the bed, for the banana suckers. The Gros Michel or Jamaican variety should be planted 14 feet square, the plants in the centre row of each bed alternating with the plants of the two outside rows.

The dwarf or Chinese variety should be planted in rows 14 feet apart but the distances in the rows may be reduced to either 10 or 12 feet. Holes should then be dug 1 foot 6 inches square and 2 feet deep, and should be left open for a short time.

PLANTING OUT.

Planting should be done when rain can be relied upon to assist the young plants, *i.e.*, at the beginning of the rainy seasons. The best time to plant is with the rains in December and January, but if bananas are required for an export trade, planting must be done so that the greatest number of bunches are timed to be ready for shipment when the market prices are at their highest. This is usually from March to the middle of August and therefore planting for the export trade may best be done in February or March.

The holes that have already been dug for the suckers should be half filled with surface soil, and, if possible, a basket of pen manure should be placed at the bottom of each.

The suckers to be used for planting purposes should be carefully chosen. The best kind of sucker to plant is that known as a "sword" sucker—a sucker that has not been cut back—as shown by the very narrow leaves. Suckers that have been cut back and have large broad leaves will not give as good results as those not pruned. They should be of good size and should appear to be strong and vigorous. They should be cut down to about 1 foot 6 inches to 2 feet above the level of the ground, and should then be dug out, the old roots trimmed off and any portion of the old parent bulb removed. They may be planted immediately or they may be left to dry—out of the sun—for a few days. It is held, however, that fresh suckers grow more readily than those that have been keept for any length of time.

AFTER-CULTIVATION.

The suckers should be planted about 6 inches deep and the earth carefully pressed down around them. After about three months growth, the holes should be filled to the top with earth and rammed well.

After the suckers have been planted, the land should be carefully weeded as it becomes necessary and an occasional forking of the soil should be given. This cultivation should be continued until fruiting is commencing, when forking should be discontinued and only the weeding practised. After the fruit has been picked, the old stems are chopped up and spread over the land, and are finally

forked in and new suckers allowed to grow up. Occasional forkings and constant weedings should again be carried on until the next crop is being produced.

Bananas may be ratooned for 3 or 4 years, afterwards the old stools should be dug out, and the beds replanted between the old rows, with fresh suckers from another locality if possible.

Bananas do not give the best results in exposed situations and it will probably be found that on many of the lands in this colony the larger growing varieties, such as the Gros Michel or Jamaican variety, will have to be staked in order to prevent their being blown over by the wind.

MANURING.

To obtain the best results, careful attention must be given to cultivation, and manuring must not be neglected. All the suckers, dead leaves, and old stems should be forked into the land to form humus, as also should all the weeds that are from time to time cut down. When pen manure, cane trash, rice straw and bush are procurable, they should be forked in, for they have a high manurial value and they considerably improve the general texture of the soil. Rice straw has a high manurial value, and could be put to good purpose in banana cultivation. It may be applied as a mulch during the dry weather, and should be gradually worked into the land. Analyses of rice straw at the Government Laboratory show that rice straw contains ·7 per cent. of nitrogen, ·2 per cent. of phosphoric anhydide and ·4 per cent of potassium (as oxide). The greatest attention should be given to the addition of pen-manure and other humus-forming substances where the soil is poor, and if the growth does not appear to be satisfactory, artificials may be used. Sulphate of ammonia, to the extent of 1 cwt. to 1½ cwt. per acre, would give satisfactory increases in return.

REMOVAL OF SUCKERS.

By far the most important operation in banana cultivation is the removal of such suckers as are not intended to yield fruit. Not more than three plants should be left to each stool. All others should be removed as early as possible and should never be allowed to grow to more than two feet in height.

They should be cut by means of a shovel away from the bulbs of the plants that are being left. The shovel should have its cutting edge away from the plant, and the sucker must be cut away down to the white, hard part, or otherwise it will soon spring again. To simply cut the suckers off at the level of the ground and not to attempt to sever them from their parent bulbs is a waste of time.

FRUITING AND PICKING OF FRUIT.

In newly planted bananas, the usual time before the fruit makes its appearance is from 10 to 12 months, and the fruit takes from 3 to 4 months before it is ripe. Thus the first crops take from 13 to 16 months before they are ready for picking. The second crop comes on about 3 to 5 months after the first. Ratoons bear in from 14 to 16 months. The time in each district varies slightly, and the exact time for any locality can therefore only be accurately ascertained by experience.

In picking the fruit the plants should not be felled so that the bunches fall to the ground. The stem should be cut partly through fairly high up, so that the bunch falls gently and can be caught by a second person. It should then be severed and wrapped in soft banana trash. Bunches of bananas should be kept dry and should be shaded from the sun. Unbruised bananas are worth considerably more than those handled roughly. Bunches intended for shipment should be cut about 15 days before they would be ripe. In cutting off the small end of the banana spike care should be taken to leave not less than 4 inches beyond the last "hand" of the spike. This operation may be performed in the field some time before the bunch is cut.

PACKING FOR TRANSPORT.

The Gros Michel or Jamaican bananas are shipped naked, *i. e.*, they are not packed into crates. The bunches are taken out of the banana fields, wrapped in trash and handed carefully into a cart or punt where they are carefully packed so

that they cannot get bruised. Afterwards they are similarly transferred from the carts or punts into the steamers for shipment.

The dwarf or Chinese banana must be carefully packed into crates. The following method is generally adopted:—The bottom of the crates are first covered with a layer of banana trash and each bunch is then wrapped in cotton wool and finally in paper. Strings of the sheath of the banana leaf are then lightly wrapped round the sheets of paper to keep them in position while the bunch is being put into crate. The bunch is now carefully placed into the crate and the banana trash is stuffed around it until sufficient has been put in to prevent the paper from unwrapping. The strings of the leaf-sheaths are then cut and drawn out, and more banana trash is pushed in until the bunch is firmly fixed in the crate. The top of the bunch is also well covered with trash, and the slats that form the top are nailed on.

TRANSPORT.

The Gros Michel or Jamaican bananas are graded at the port of shipment but in the case of the dwarf or Chinese variety, each crate should have the shipping mark and a mark indicating the quality of the fruit stencilled on that end of the crate containing the flower or small end of the bunch.

In shipping dwarf bananas, the following method of marking is practised:—A bunch weighing when in the crate from 40 to 49 lbs. (gross) should have one "X" marked on the end of the crate, a bunch weighing 50 to 59 lbs. "XX," one weighing 60 to 69 lbs. "XXX" or so on.

Bunches which weigh more than 60 lbs. should always be shipped by themselves, but when they weigh less, they may be packed two in the same crate, side by side. This fact should be indicated by putting the figure 2 after the "X's" marked on the end of the crate.

DESTRUCTION OF OLD STEMS.

In Jamaica, after the bunch is cut, the head of the plant is severed completely from the stem about 2 to 3 feet above where it was partly cut through in order that the bunch might fall for picking. This top part of the stem, as well as the leaves, is cut up into small pieces and spread over the ground for manurial purposes. The lower portion of the stem is left to decay, and it is not severed low down near the ground as it is thought that a large proportion of food-material in the stem passes downwards into the bulb. In some other countries, after the bunch is cut off, the whole of the old stem is cut down near the groud and chopped into small pieces and opened over the land. It has yet to be demonstrated which of these two methods gives the best results.

DISEASES.

Diseases of bananas are fairly common in some countries, mainly where they are grown in unsuitable or impoverished soils. A disease has recently done enormous damage to bananas in Panama and other diseases are not unknown. In this colony, the bananas fortunately are fairly free from disease but a disease of plantains has long been known. Diseased stems exhibit internal decay and the leaf-sheaths turn to a sodden, putrid mass, while the roots and root-stock also rot away. Very wet weather materially increases its prevalence on heavy new land. Good drainage and high planting appear to reduce its ravages. It is frequently common on newly empoldered lands where the drainage is poor.

Good drainage and careful cultivation are essential for successful banana or plantain culture as fungus disease or diseases of the roots caused by nematode worms are greatly increased by lack of attention to these important points. All diseases noticed in bananas or plantains should be at once submitted, with specimens, to the Department of Science and Agriculture for investigation in order that remedies may be devised if possible.

—F. A. STOCKDALE.

Recording Dairy Returns.

"Good morning, Mr. Brown. My word, you have some very fine cows amongst your herd!"

"Well, yes, there are some good cows. A few better than others, but, taking them altogether, I dare say you will not find many better herds in the district."

"What kind of returns do you get from them?"

"There are 67 altogether, and my last cheque amounted to £43; not bad for four weeks' supply."

"Yes, that is not bad, but do you not think it possible to increase the yields? Do you keep any record of the individual returns secured from each cow?"

Mr. Brown smiled and looked at me suspiciously, wondering at my — to him — outlandish suggestion.

I hastened to explain that amongst the most advanced dairymen such a rule was in everyday practice, and quoted an instance of one who had eleven cows and could tell the daily, monthly, and yearly returns of each cow for the last four years.

Mr. Brown remarked that such was possible, no doubt, on the part of a man who had not much to do, and who wanted some means of occupying his time. It was practicable to carry out such a method with a small number of cows, and was probably worth while, under such circumstances, but with a large herd it was impracticable and out of the question.

"It pays, and if it is possible in one instance, it should be in another." I then mentioned a case where a herd of 150 cows was —by a system of recording individual returns—made to double the former average yields in two years by methodical culling and management.

"What would a grocer do if he did not keep accounts? At the end of the month or quarter, it would not do to average his customers' bills."

"H'm: I'll think it over."

Knowing from previous experience what the result would be, I decided to remain and see the method started.

"Which of your boys takes the most interest in this branch of the farm operations?

"Well, Tom, I believe, does. Here, Tom!"

As Tom appeared in considerable doubt, and to resent any additional imposition of duties in connexion with milking opera-

tions, I went on to explain, and asked for a sheet of Imperial size paper ; that is about 30 inches by 20 inches."

"There is no such paper on the place excepting a newspaper, and I suppose that would not do?"

"Well, a large almanack or show programme, or by the way, if you have any brown paper about the house from the draper or grocer."

A search was made, and from a bundle of various sizes, shapes and conditions of brown paper, I selected a few sheets, and taking one asked that the remainder be put aside for future use With a ruler I quickly ran off 68 vertical spaces and 64 horizontal lines, the highest being 2 inches from the top, then along the top of same the name of each cow was entered, and down the left hand margin the dates were inserted, the sheet was then tacked on the wall near where the milkers strained the milk into cans. It was a copy of that on the next page.

On asking for scales none suitable were available, so I told Mr. Brown and Tom that I would be back again in time for the afternoon milking. In the meantime I bought a spring scales to weigh up to 56 lbs. for 2s., and suspended same with a piece of wire near the chart. A lead pencil was attached to the wall with a string so that it would be always available.

Milking commenced, and I could see Mr. Brown was somewhat impatient and regarded the arrangement with suspicion, and remarked that the usual time occupied by milking the whole of the cows was just two hours, and with this innovation he doubted whether the cows could be got out of the yard inside three hours. At any rate, he resigned himself to the situation, no doubt thinking that when I was gone the chart would disappear as soon as Tom's interest flagged.

Each bucket was weighed separately, and the weight marked on the handle with a file ; three weighed 4 lbs., and the remainder $3\frac{1}{2}$ each. When the first bucket came along with "Jennie's" milk, the weight of can and milk was found to be 20 lbs., bucket 4 lbs., net weight of milk 16 lbs., date of the month, 7th. "Jennie's" column was found at a glance, and 16 entered on the lower space and opposite 7th. This took some time, as all the other hands stopped milking to watch the proceedings. I told them there was no necessity to do this, as each would have an opportunity of learning when they brought their quota along from each cow. I considered this warning necessary, as much depended on the time taken in doing this new work.

MONTHLY CHART.

For the guidance of Dairymen in recording each Cow's Milk.

NAMES OF COWS																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
DATE	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M	LB M
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								
15																								
16																								
17																								
18																								
19																								
20																								
21																								
22																								
23																								
24																								
25																								
26																								
27																								
28																								
29																								
30																								
31																								
TOTAL																								
TESTS 1 WK																								
2ND																								
3RD																								
4TH																								
AVG.																								

The first weighing in each case was necessarily slow, as a full explanation of the method had to be made to the milker; but before the milking was half through they were all able to find the places and read the weights without any difficulty, but Mr. Brown had in the meantime exhausted his patience and gene off to other duties. Tom, however, was interested, and had taken in hand the supervision of the system When the cows were turned out, it was found that some ten minutes additional time was occupied. I explained that with a little practice the delay would be less, and in time the method would become part of the milking process. The whole of the milkers gathered round, and anxiously studied the figures; one was engaged in mentally adding the yield of the particular cows he milked for the evening, whilst another was laughing at "Jennie's" downfall. "Jennie," I learnt, was reputed to have been the heaviest milker; but the eye and the size of the bucket proved to have been at fault, and "Spot" had really given 19 lbs., whilst "Jennie's" came to 16.

I had another talk to Tom before leaving, and secured a promise from him that the system of recording results would be persevered with till the end of the month at least. At the end of the month Tom wrote me to say that he had ruled and set up another chart for the next term, and referred to the yields of the big brindle cow and some other members of the herd.

It was some two years later that I visited Mr. Brown's dairy farm, and Mr. Brown did not seem less pleased to see me than his intelligent son. An exercise book was produced a few minutes after my arrival, and I was shown the actual returns secured from each and every cow.

On asking what the cheque from the factory this month was, I was smilingly informed that it was £59 odd from 61 cows.

"And the price paid by the factory?"

"Was 8½d., why, just the same price as for the month you were here before."

Tom said—"My word, sir, we found out some things before many months had past, we learned that some cows were little better than boarders who didn't pay their bills in full, and it was easy to show Dad that they were not paying for their grass and attention, so they were quickly put dry, fattened and sold to the butcher, and now we know which cows pay us best and which to rear the heifer calves from. Although you say the returns are good, we are quite satisfied that in another couple of years we will be getting much larger returns. There is really no limit to

this method; we can see that if all the cows were as good as the best twenty, the annual returns would be increased by 50 per cent."

—Mr. R. Crowe (Superintendent of Exports)
"Journal of the Department of Agriculture, Victoria, (Australia.)"

Food Value of Red Sorrel Seeds.

Seeds of Red Sorrel (*Hibiscus Sabdariffa*) were submitted to the analysts of the Imperial Institute by the Forestry Officer of Northern Nigeria; and the following results were obtained:—

	Per cent.	
Moisture	7·4	
Ash	5·0	containing 39·7% phosphoric acid, P_2O_5
Fat	19·8	
Crude fibre	15·5	
Albuminoids (Nitrogen x 6·25)..	26·8	
Other nitrogenous substances—trace		
Carbohydrates and other non-nitrogenous substances (by difference)	25·2	
Nutrient value	97·54	
" ratio	1 : 2·6	

In the following table, these results are compared with those given by other feeding materials for cattle, namely, linseed-cake and cotton-seed cake.

In Percentages.	Moisture.	Ash.	Albuminoids.	Fibre.	Fat.	Carbohydrates.	Nutrient value.
H. Sabdariffa seeds	7·4	5·0	26·8	15·5	19·8	25·2	97·5
Linseed cake—new process... ...	9·4	5·4	35·6	7·1	7·5	35·0	87·8
Linseed cake—old process	10·8	5·0	28·6	6·7	10·6	38·3	91·3
Cotton-seed cake—new process ...	11·1	6·1	38·5	9·8	8·3	25·7	84·4

In spite of the high nutrient value, the amount of indigestible matter or crude fibre present considerably diminishes the value of the seeds as a feeding stuff for cattle. In view of this, the Imperial Institute authorities remark that 'increased production of this grain as a food stuff is not advisable.'

—*Vide* Bulletin, Imp. Inst, vol. VII, No. 2, 1909.

The Experimental Error in Field Trials.

The following is a brief abstract of an article contributed by Mr. A. D. Hall, F.R.S., the Director of the Rothamsted Experimental Station, England, in the Journal of the Board of Agriculture, England, for August last, on the errors to which all experimental work in the field is liable :—

Error is inevitable in all experimental work and it is always desirable that an effort be made to decide whether the error is such as will vitiate the conclusions drawn from the experiment. Field trials are always liable to a large number of sources of error, and it is of the utmost importance in drawing conclusions from such experiments to know what degree of accuracy in the results can be expected, supposing all the conditions to have been favourable.

Fields, after plots have been laid out, may from the results show several great variations in the soil, due either to a change of subsoil or drainage or to some past irregularity of manuring or cropping or the plots themselves may suffer irregularly from insect or fungus attack. The results from such plots must be entirely ignored and the work laid out afresh, as the error is bound to be considerable.

Supposing, however, that such sources of error are eliminated it is interesting to inquire as to what is the general experimental error in carefully conducted experiments. Figures from the Rothamsted results, which are generally recognized as being the most reliable of all agricultural experiments, show that pairs of plots receiving the same treatment do not give similar yields year by year but vary with considerable irregularity. On comparing two plots on similar soil, receiving similar treatment, it was found that one plot gave a bigger crop than the other for 37 years out of 50 but on thirteen occasions it gave less. Taking the mean of the whole period the relative yield was 110 as against 100, and was therefore 10 per cent. the better plot.

THE "PROBABLE ERROR"

of the mean result was about 2 per cent. In other words, it may be concluded that there is an inherent superiority in the first plot over

the second which is certainly more than 8 but less than 12 per cent. The mean error of a single year's result is similarly 10 per cent.

An examination of many series of experiments indicates that the mean error attached to the yield of a single plot is about 10 per cent. plus or minus. In other words, if we consider three experimental plots giving yields of 28, 30, 32 cwts. of rice, it is not correct to conclude that such differences have been brought about by the treatment, but rather that the three plots must be considered as giving, for all practical purposes, equal results.

This conclusion is an important one for all agricultural experimenters and should be carefully considered. How often is it noticed in some agricultural experiments that considerable argument is brought forward to explain slight differences of yield on different plots, when the whole of the difference did not amount to the possible "experimental error" of even the most carefully conducted experiments.

Mr. Hall has not confined his investigation to Rothamsted results alone but he has examined experimental data from other stations to gain an idea of the average error in field experiments, and has arrived at the conclusion that 10 per cent. is the average error under most favourable conditions and that no experimenter would be justified to form any conclusions from a single experiment that showed less than 20 per cent. differences.

The only way to reduce this experimental error and to obtain a closer result is to multiply the experiments by repeating them for a series of years and by increasing the number of plots. The number of plots set aside for each kind of treatment should be increased and should be irregularly distributed about a field.

It is Better

to take thirty plots of a tenth of an acre, six different kinds of plots and five of each kind, than six plots each of half an acre. Such a form of experiment is necessary if small differences are to be brought out, and if the special variations induced by the character of the season are to be eliminated. Increased accuracy is not to be obtained by increasing the size of the plots so long as the plots are above $\frac{1}{40}$th acre each. Large plots are likely to have more or less pronounced irregularities of soil, but the difficulty of getting the various cultural operations carried through in the same day introduces a further source of error.

Further, Mr. Hall is of the opinion that the taking of large plots and then selecting small areas within the plot for weighing

introduces the most fatal error of all—a selection biased by the preconceived opinion of the experimenter. Such a method is to be thoroughly condemned, as also is the practice of making allowances for missed plants.

British Guiana Sugar-Cane Experiments.

The experimental error in field trials has always been given careful consideration by the Department of Science and Agriculture in its sugar-cane and other experiments. In laying out the sugar-cane manurial experiments in 1890 the draft scheme was submitted for the consideration of the then authorities at Rothamsted (Sir John Lawes and Sir Joseph Gilbert). None of the plots are less than $\frac{1}{33}$, while the majority are from $\frac{1}{30}$th to $\frac{1}{25}$th of an acre in area. They are divided into halves, which receive different treatments with calcareous or phosphatic manures. These halves are not considered as separate units but are always considered together. By keeping the plots of fair area and by duplicating or triplicating the experiments against a good number of controls it has been possible to keep the experimental error within reasonable limits. Whereas 10 per cent. has been shown to be the average possible experimental error and 2 per cent. as the probable error for carefully conducted experiments with cereals, such as wheat, etc., it is our experience with sugar-cane experiments that the errors are higher.

On page 55 of the Report on the agricultural work for the years 1893-5 and on pages 43 and 44 of the Report for the years 1896-1901, it was pointed out that during each crop there had been observed in the manurial experiments with sugar cane a large range of variation in yields both on the non manured and the manured series of plots, a result that would not have been expected from the uniform lay of the field or from its previous history. Each series occupied a little over half an acre, and if each half acre had been differently manured the result of the manurings would either have been greatly exaggerated, or obscured, and it was only by the use of small plots and by comparing the yield in each series with the mean yield of the diagonally situated non-manured plots that the results obtained in the different series of a group of experiments fairly corroborated one another and could be considered of value.

Even with the use of these small plots carefully laid out the experimental error is considerable, as may be seen from an examination of returns per acre. Nine plots, each non manured and man-

uerd, in the manurial seiies with Bourbon cane for six crops, extending over the period 1891–1899, gave the following resu'ts :—

BOURBON SER ES—NON-MANURED.

Number of Plots.	Yields in tons produce per acre.	Percentage yield on mean yield.
1	23.	109.4
18	20.4	97.1
25	19.	90.5
38	18.2	86.6
52	22.6	107.6
54	20.2	96.2
73	19.5	92.8
75	23.1	110.
77	23.	109.4
Mean	21	100.

BOURBON SERIES—MANURED WITH 60lbs. OF NITROGEN.

Number of Plots.	Yields in tons produce per acre.	Percentage yield on mean yield.
5	31.8	112.3
14	26.5	93.6
29	26.	91.8
50	27.6	97.5
55	24.1	85.2
57	28.8	101.7
64	30.3	107.
66	30.3	107.
71	31.7	112.
Mean	28.3	100

It will be seen from the above that the non-manured p'ots gave a maximum plus error of 10 per cent. and a maximum m'nus error of 13.4 per cent. or a mean plus or m'nus error of 11.7 per cent The manu ed plots gave a maximum plus error of 12.3 pe cent. and a maximum minus error of 14.8 per cent. or a mean plus or minus error of 13.55 per cent.

Turning now to manurial experiments with the seedling 625 for six crops during the period 1901-1908, the following results were obtained:—

D. 625.—6 PLOTS NON-MANURED.

Number of Plots	Yields in tons produce per acre.	Percentage yield on mean yield.
14	40.5	88.4
18	39.5	86.2
38	53.9	117.6
41	48.3	105.4
61	41.6	90.6
64	51.2	111.7
Mean	45.8	100.

D. 625.—3. PLOTS MANURED WITH 40 LB. OF NITROGEN. PER ACRE PER CROP.

Number of Plots.	Yields in tons produce per acre.	Percentage yield on mean yield.
16	53.3	98.3
37	56.9	105.
62	52.5	96.7
Mean	54.2	100.0

D.625.—3. PLOTS MANURED WITH 80 LB. OF NITROGEN. PER ACRE PER CROP.

Number of Plots.	Yields in tons produce per acre.	Percentage yields on mean yield.
13	53.6	92.1
42	57.8	99.3
65	63.2	108.6
Mean	58.2	100.

If we consider the errors in the non-manured plots and those in the manured ones, it is noted that the non-manured plots gave a maximum plus error of 17.6 per cent. and a maximum minus error of 13.8 per cent. or a mean plus or minus error of 15.7 per cent. while the manured plots gave a maximum plus error of 8.6 per cent. and a maximum minus error of 7.9 per cent., or a mean plus or minus error of 8.45 per cent.

Similarly the results of four non-manured plots of seedling 109 for crops during the years 1901–8 gave a maximum plus error of 12.8 per cent. and a maximum minus error of 9.8 per cent. or a mean error of 11.3 per cent. plus or minus, while four manured plots over a similar period gave a maximum plus error of 6.4 per cent. and a maximum minus error of 4 per cent. or a mean error, plus or minus, of 5.2 per cent. Considering therefore the means of all the different series given above the maximum mean plus or minus error is 15.7 per cent. and the minimum mean plus or minus error is 5.2 per cent. or a mean error for all the different plots of 10.9 per cent. plus or minus; a result but slightly in excess of the figures worked out by Mr. Hall for cereals in England. Having established that the possible experimental error in the sugar-cane experiments is nearly 11 per cent., it is of interest to ascertain what the probable error may be taken to be and what percentage results the manures have given. To ascertain the probable error it is necessary to obtain the probable mean plus error and the probable mean minus error, considering the plots individually. The probable plus error is 3.9 per cent. and the probable minus error is 3.6 per cent. or a probable error, plus or minus of 3.75 per cent. which for practical purposes may be considered as 4 per cent. For the manurial experiments conducted in British Guiana, the possible error is therefore nearly 11 per cent. while the probable error is 4 per cent. plus or minus.

Taking the mean of the non-manured plots as 100, the mean effect of 60lb. of nitrogen per acre per crop with Bourbon cane over a period of nine years was 133.8, the mean effect of 40lb. of nitrogen per acre per crop over eight years with D. 625 was 118.3, and of 60lb. of nitrogen of 127.3, while with D. 109 the mean effect of 40lb. of nitrogen was 116.6, and of 60lb. of 128.8—results well in excess of even the possible error, and therefore

THE CONCLUSIONS ARRIVED AT

in connection with these experiments may be considered to be warranted.

LIBRARY
TNAU, Coimbatore - 3

It is more than probable that the errors in respect to variety experiments are considerably greater than in manurial experiments with the same variety. Consequently the resolution passed by the Sugar-Cane Committee of the Board of Agriculture in 1901 to the effect that 'the results obtained by the experiments on the small plots which it was necessary to employ during the earlier stages of the enquiries into the relative values of new varieties of seedling sugar-canes cannot be received as indicating those consequently obtainable on the commercial or economic scale, the conditions of whch in important respects are necessarily materially different' can only be considered as very sound policy, while the recent resoution of the Sugar-Cane Committee to consider only the means of varieties cultivated on estates, where methods of cultivation, manuring, etc., produce much greater possible errors than under the conditions prevailing at the Experimental Fields, on areas in excess of twenty acres tends to reduce to a considerable degree these experimental errors, and should give much more reliable results as to the economic value of a certain variety of sugar-cane than if, as in some colonies, the conclusions, were based upon small areas of a few acres each.

The calculation of the manurial effects on different varieties has occasioned a certain amount of difficulty in the experiments of the Board of Agriculture, as the area is limited and expense has to be curtailed as far as possible. The number of control non-manured plots has been increased, and it has been found that the most reliable data with regard to the relative value of various kinds of sugar-cane is attained by taking the mean results of growing them under several different systems of manuring. For instance, in the more complete of our trials each of the varieties is contrasted under twelve variants as regards manurial treatment.

Rice Experiments.

The manurial or variety experiments with rice have not been carried for a sufficiently long period of time for the possible errors to be calculated out with accuracy, but the system of laying out a fair number of plots each not less thun $\frac{1}{20}$ acre, scattered througout the field, with a sufficient number of control plots, has been adopted, and it is to be presumed that the errors will not be any greater than those for the sugar-cane experiments, and it will not be surprising to find when definite calculations are made, that the errors are much smaller.

Cacao Experiments.

For cacao experiments, it is impossible to surmise even a possible error, as there are so many factors, not present in experiments with

non-permanent crops, that have to be given careful consideration. Very few, if any, cacao fields, consisting of the same variety of cacao, exist anywhere; very few plots can be found which contain the same number of full-bearing trees planted at equal distances apart(and the yield of cacao trees varies considerably with the number of trees planted to the acre), and most important of all, there is the individuality and periodicity of the trees to be considered, whilst the disease question is not one to be neglected. In fact, results from experiments with permanent trees must be treated with the utmost caution until they have been carried on for a long period of time against a sufficient number of controls, and until due regard has been taken of the many disturbing factors in the experiments. The manurial cacao experiments at Onderneeming have now been carried on for one period of four years against a number of controls, but we do not yet feel justified in drawing any definite conclusions from them. In fact, it has just been decided that the same manurial treatment shall be continued for another four-year period to compare with the results obtained so far, in the hope that some definite and reliable conclusions may be arrived at. It is thus hoped that the possible error in carefully conducted experiments with permanent crops such as cacao may be ascertained.

J. B. HARRISON,
F. A. STOCKDALE.

October 7th, 1909.

To Ascertain the Ripeness of Sweet Potatoes.

When the sweet potato is ripe, the sap has reached what may, with some propriety, be termed the crystallisable stage —*i.e.*, when the root is cut or broken and exposed to the air, a white crust or artificial skin is formed over the cut part, and protects it from the air and from the agencies of decay. If it is not ripe, the cut part turns black, and no such artificial skin is formed. If, therefore, proper judgment is exercised as to the time and manner of digging, handling, and storing, there is little danger of loss.

—Q. A. J., July 09.

The Building up of Carbohydrates in Plant Cells.

The .003 per cent. of carbonic acid in the air, kept in equilibrium by the mutual exchanges of plants and animals, is, together with water, the initial food for the building up of carbohydrates.

Despite the achievements of the past twenty years in advancing the knowledge of their structure and synthesis, comparatively little is known of the process of reduction in the living cells that precede the formation of sugar, starch, and cellulose. The very varied and intricate character of these changes, and the fact that they are always associated with the presence of highly complex molecules, of which chlorophyll is the most characteristic, and with enzyme action, make it exceptionally difficult to obtain any insight into the constructive stages of plant assimilation. The earlier products of the change have, in all probability, only an ephemeral existence, so that special methods are required to remove them from the sphere of action as they are produced, in order to obtain satisfactory evidence of their formation.

The most generally accepted hypothesis of the nature of the change is that advanced by von Baeyer, according to which the carbon dioxide is first reduced to formaldehyde, from which the carbohydrates result by polymerization, the initial reduction taking place with liberation of oxygen, in accordance with the equation:

$$CO_2 + H_2O = CH_2O + O_2$$

Formaldehyde.

From the purely chemical side the possibility of this hypothesis is well established. . . According to the investigations of Brown and Morris, cane sugar is

THE PRIMARY CARBOHYDRATE

that is formed in plants; fructose, dextrose, and maltose are also present in the green leaf, whilst the more complex carbohydrates, starch and cellulose, are the characteristic final products of assimilation. Despite numerous hypothetical suggestions, the laboratory syntheses of these products from fructose have hardly been approached.

The conditions under which laboratory methods have been able to give support to von Baeyer's hypothesis are, of course, entirely different to those that obtain in the natural synthesis of carbohydrates in living plants, and until recently there has been no satisfactory physiological evidence in its favour. A number of experiments have been carried out on feeding plants with formaldehyde and its simpler derivatives, which have shown that certain plants can form starch when treated in this manner. Such evidence, however, is only indirect, because the formaldehyde may itself be first polymerized to a sugar, independently of the vital action of the plant, and it is known that plants can form starch from sugar in absence of light. More direct and complete evidence of the nature of the changes during assimilation has now been established by the investigations of Usher and Priestley, who have proved the presence of formaldehyde as an initial change in the reduction of carbon dioxide by plants on exposure to sunlight. Its production is accompanied by the formation of hydrogen peroxide, which is decomposed by a special enzyme with the liberation of oxygen, whilst the formaldehyde is taken up by the living protoplasm and polymerized, with the formation of carbohydrates. The reduction of the carbon di-oxide takes place, in sunlight, with leaves in which both the enzymes and the protoplasm have been killed by immersion in boiling water, so that the change appears to be

INDEPENDENT OF THE VITALITY

of the leaf. These results have been confirmed by Usher and Priestley in a most interesting manner, by allowing carbon di-oxide to act upon thin films of chlorophyll under conditions approaching those under which it is present in the green leaf. On exposing such films to sunlight, formaldehyde and hydrogen peroxide are formed, and by introducing a suitable catalysing enzyme, oxygen is liberated from the latter. Further, they have shown that in presence of certain kinds of living protoplasm, free from chlorophyll, starch and oxygen are the final products of the assimilation, as in the case of growing plants. Formic acid appears to be an intermediate product in the initial reduction of the carbon di-oxide to formaldehyde, so that this stage in the assimilation is to be represented by the equation:—

(i.) $CO_2 + 2\,H_2O = CH_2O_2 + H\ \ O$,
Formic acid.

(ii.) $CH_2O_2 + H_2O = CH_2O + H_2O_2$.
Formaldehyde.

(iii.) $2\,H_2O_2 = 2\,H_2O + O_2$.

The chemical evidence of the nature of the subsequent stages in assimilation is very deficient, as stated, and on the physiological side this deficiency is, at present, still more marked.

—C. A. Keane, D.Sc., Ph.D., F. I. C.,
in "Modern Organic Chemistry" (1909).

From purely chemical reasoning it may be assumed for the present that formaldehyde may be one of the intermediate products in the formation of carbohydrates in plants from crabon-di-oxide, but experimental evidence from the biological point of view is not sufficient to warrant the conclusion that formaldeyde is normally produced as such in the plant. Similarly it cannot yet be taken as having been proved that formic acid and hydrogen-per-oxide are normally produced in the plant. [Ed. J. B. of A.]

Is Rubber a Waste Product?

"Exception has been taken to the statement recently made in this column that the rubber in *Hevea* is a 'waste product.' There have been practically no experiments or observations in this direction, the majority of investigators having occupied themselves with the question of obtaining the maximum amount of rubber from the tree without troubling themselves to consider how and where it was formed. The following observation tends to support the 'waste product' theory. If a naturally shed *Hevea* leaf is taken and a thin layer of the midrib on the back of the leaf is peeled off slowly, strands of rubber will be seen stretching across the angle between the strip which is being peeled off and the remainder of the midrib. This shows that when the leaves are shed naturally, *e.g.*, at the initiation of the 'wintering' stage, the rubber which they contain remains in them. The same result may be obtained with rather more trouble by extracting the rubber from the fallen leaves by means of carbon bisulphide. Now, according to Sachs' investigations, before a tree sheds its leaves all the potash, phosphoric acid, starch, etc., in them—in fact everything which can be of further use to the plant—is transferred from the leaves to the stem. The dead leaf retains only waste products. The fact that the rubber is cast off in the dead leaf tends therefore to support the view that it is also a waste product.

—Mr. T. Petch: in "Tropical Agriculturist" (Ceylon).

Alcohol v. Petrol for Motors.

As the output of sugar in Natal is increasing by leaps and bounds (writes Mr. C. W. Petchell in the Agricultural Journal of that colony), the supply of treacle (molasses is increasing. Last year there was manufactured in Natal approximately 45,000 tons of sugar. This means that there was about 3,000,000 gallons of treacle made. Of this there is no doubt that a large amount was wasted. A certain amount was sold to natives, some was made into rum, whilst a considerable quantity was shipped to England. I am strongly of the opinion that it would pay much better to make it into a motor spirit if once the public could be got to use it.

With the latest plant, one gallon of 65 overproof spirit can be made from two gallons of treacle. If we take it as three gallons, there is enough treacle manufactured to make one million gallons of motor spirit yearly. And each year the amount is increasing.

After an experience of over five years with the use of denatured alcohol in motor car engines, I unhesitatingly say that it can be used in place of petrol in engines of the ordinary type, provided that a suitable carburetter or vapouriser is used. In many cases the existing one may be altered to give perfectly satisfactory results. There are certainly some drawbacks to its use, but they are not insuperable, whilst, on the other hand, it has some decided advantages. Many of the objections alleged against it are merely bogeys.

What appears to be the most serious drawback is the action of the acid fumes set free on the explosion of the charge. This is not noticed if the engine is worked daily. But the metal of exhaust valves and seats is certainly affected if the engine is simply stopped and left alone for some weeks. This difficulty is easily overcome by injecting paraffin into the cylinders while hot and giving a few turns by the hand. When this has been done the signs of corrosion are entirely absent even after a stoppage of several months.

On the other hand, there are certain decided advantages in its use. The engine runs more freely, there is practically no pre-ignition, the engine develops more power, whilst the exhaust fumes are not nearly so objectionable as from petrol. It must be thoroughly understood only pure alcohol of not less than 65 over proof should be used. A great deal of spirit which is denatured and sold as methylated spirit in Natal is very corrosive and utterly unsuitable for motor work. I have found that with impure spirit a soapy shiny growth or deposit forms on the tank, and on any gauze strainers that may be used, be-

sides chokin u any of the small copper pipes which convey the spirit to the carburetter. Impure spirit also corrodes the tank, and any metal with which it may come in contact. I feel that I cannot too strongly emphasise the necessity for using only a pure spirit. In fact a stringent inspection before allowing it to go on the market is just s necessary as in the case of fruit or mealies for shipment.

To compete with petrol at its present price in Natal, viz., 1s 6d. per gallon, denatured alcohol should be sold at not more than 1s. per gallon at the outside. It could be easily be sold at that price and a fair profit made, and could be sold at considerably less if the most suitable denaturant "benzol" was made in the colony; and there is no reason why it should not be.

To make the industry a success, central stills of the best and latest designs should be erected to which the planters could send their treacle, or a crude spirit could be made on the estates and sent to the central still to be rectified or redistilled.

Are Sweet Potato Vines good for Horses ?

Great care is needed in feeding sweet potato vines to any stock. Analyses of the vines have shown that they yield as much as one grain of prussic acid (a deadly poison) per lb. of the green feed. In 1905 numbers of pigs died from eating sweet potato vines. If used at all for stock, it should be given very sparingly.

—Queensland Agriculture Journal, June, 1909.

Manure for Sweet Potatoes.

Where the soil on which sweet potatoes are to be grown requires manure, the following mixture will be found to be very efficacious after applying stable manure or ploughing under a green crop :—

90 lb sulphate of potash	per acre.
90 lb high-grade superphosphate	
90 lb Chili saltpetre	

or instead of 90lb high-grade superphosphate, use 225lb super phosphate 16 per cent, Mix well.—Q. A. J., July, 1909.

Notes on Orchid Growing.

For the successful cultivation of the larger part of this peculiar and delightful race of plants, an atmosphere either naturally humid or rendered so artificially is absolutely essential. It was at one time considered that orchids could only be successfully cultivated in glass conservatories, but it has been conclusively proved that—from the want of sufficient ventilation probably — such depositories are not suited to them. One main point, formerly not given due consideration to, was a sufficiency of light. It is a mistake to think that these plants live in the dark in their native localities and that a situation where no sun can reach them is the one best adapted to them. They live, it is true, in the shade cast by the foliage of the trees on which they are suspended or beneath which they grow; but that foliage is not altogether, and at all times, impervious to the rays of the sun; and, moreover, when the trees lose their leaves—as many do—the plants must needs be subject to a very considerable expoure to full sunshine. This would have the effect of ripening their wood, and thus causing them to bloom. It becomes a question then if there be not those which it would be desirable to remove from the shade house and subject to the full influence of the sun during at least some portion of the year. Even the varieties which are shade-loving require light, though not direct sunshine; for they will not thrive in dark corners. All like a moist atmosphere when in a growing state and as their life is sustained by the moisture they obtain from the air, the surroundings should always be kept damp when the plants are in full vigour of growth. I have grown some beautiful orchids from New Guinea with no other shade than that afforded by peach trees, which, as we all know, are deciduous and hence leafless for several months of the year. The Laelias, Coryanthus, and similar generally love full exposure to the rays of the sun.

Propagation and Potting.

Some orchids are easily increased by dividing them into pieces, or by cutting the old pseudo-bulbs from the plants after the latter have done flowering. The best time for this is just as they grow, or when they are at rest. They should be cut through with a sharp knife between the pseudo-bulbs, being careful not to hurt the roots. Each piece should have some roots attached to it. They should be parted and potted, and receive no water until they begin to grow. Different modes of growing them are adopted, suited to the peculiar habit of each. Some thrive best fastened with moss upon the bough of a tree, or upon a log, some in open-work baskets of wire or wood, and

some put in pots. The time for re-potting these last is at the close of the period of rest, just as they begin to start their growth. Previous to potting, it is laid down as indispensable that they receive no water for a few days. In potting or basketing orchids care should be taken that the eyes of the plant are not covered. They are always at the base of the previous year's growth, and it is of vital importance that the potting material does nor cover them. Fill the receptacle partly with broken crocks, cover this with some moss or similar material to prevent the compost from clogging the drainage; then add the compost and see that the orchid is potted firmly and staked so that it is fairly rigid. If any of the roots are dead or broken it is better to sever them with a sharp knife. See that the roots are not dead or broken in any way when potting, and, above all, do not over-pot. Orchids, as a rule, do better in small receptacles than in large ones. To a beginner this may be difficult to understand; but is a fact worth remembering. Do not allow the compost to become wet or sour, or the plants will not thrive, and will be attacked by disease. Perhaps the most important point of all in the cultivation of these choice plants is — absolute cleanliness. In their native homes, upon the lofty trees of humid forests, very little dust can ever find its way to them, whereas wherever they are grown artificially—in trees in the garden, in bush-houses or on verandahs—they cannot remain many days before they become loaded with dust and dirt. This as it accumulates, must be scrupulously removed. It is a work of patience, but it must be done; and no plan answers better for the purpose than to use a sponge and soap and tepid water, washing carefully each leaf of each plant, both upper and lower surfaces, changing the water frequently as it becomes dirty. I need hardly observe that the cleansing work must be done with a light hand, and the plants subjected to no rough usage.

—Mr. A. J. Boyd, F.R.G.S.Q., in "Queensland Agricultural Journal."

A Remarkable Coconut Palm.

In the July number of the Agricultural Bulletin of the Federated Malay States is given a photograph of an exceedingly prolific coconut tree grown on Klanang Estate, Jugra, in Selangor. The tree is only eleven years old and the total number of nuts on the tree at the time at which the photograph was taken was more than 360. This must surely be a record.

Hints Scientific and Practical.

Under this heading we propose to give, in each issue of this Journal, a number of quotations from recognized authorities, bearing upon Agriculture on both its sides, the purely scientific as well as the severely practical. In this way we hope to assist those of our readers to whom the procuring of a standard book or books of reference is a matter of time or difficulty.

Treatment of Pegass Soils. Muck* soils are formed by the decay, in wet places, of grasses, weeds, twigs, leaves, and even trees. Being so largely formed from vegetable matter, they are much richer in nitrogen than ordinary soils. They usually also contain small amounts of phosphorus and potassium. It is recognised, of course, that proper drainage is a necessary pre-requisite to the use of muck soils, for if muck soils are to be cultivated it is obvious that they must first be drained. This is necessary in order that they may become the home of the various kinds of micro-organisms that play an important part in the making of a fertile soil. These micro-organisms need moisture, but they cannot develop in mud or standing water. The method of cultivation requires particular attention. Cultivation should be deep, especially at first, in order that the air may thoroughly penetrate the soil. Muck soils often contain substances that are injurious and even poisonous to plants. When the poisonous substances are exposed to the air they are probably oxidised to a considerable extent and thus destroyed. A free circulation of the air also improves the conditions for the development of the useful micro-organisms. Muck soils are generally acid or sour, and this acidity must be corrected before they will be productive. Suitable materials for this purpose are finely ground limestone, air-slaked lime, wood ashes and marl. Finely-ground limestone (the native rock) is to be preferred to the forms commonly used, since it is effective, is more easily handled, and harm is not likely to result from the use of amounts in excess of what is needed to neutralise the acids. The importance of destroying the acids can be better appreciated when we remember that the micro-organisms that convert organic nitrogen into a form that can be used by plants cannot develop in a highly acid soil. The limestone and lime also furnish a suitable base with which the nitric acid that is formed may unite thus producing calcium nitrate, which can be taken up by plants.

U. S. Department of Agriculture: Farmers' Bulletin No. 369 July 23, 1909.

---

* N. American for "pegass."

Osmosis and the Plant. The diffusion or passage of liquids and solutions of substances through membranes in which no visible openings are present is termed 'osmosis'. The pressure set up in the interior of closed permeable membranes is spoken of as 'osmotic pressure,' and the dissolved substances upon which the pressure is primarily dependent may be designated 'osmotic substances'. A bladder or other structure distended by osmotic pressure becomes firm or rigid instead of limp and flabby, and in this condition is spoken of as 'turgid'. Dissolved in the cell-sap of all living plant cells are osmotic substances, such as sugars and salts of various kinds which have the power of attracting water into the interior, and when plant cells are immersed in pure water they become turgid. In all living parts of plants which are adequately supplied with water, and especially in those regions where active growth is going on, the cells are distended by osmotic pressure, and this state of turgidity is the cause of the elasticity and firmness exhibited by the thin-walled living parenchymatous tissues of leaves, growing fruits, and other delicately-constructed portions of plants... In the cells of fruits containing considerable amounts of osmotic substances in the cell-sap, the pressure set up in wet weather when abundance of water is conducted to them is sometimes sufficient to burst the cell-walls, and the fruits split.

"Agricultural Botany," by Professor J. Percival, M.A., F.L.S.

Phosphatic Slag and Ground Phosphates. Some phosphates when finely-ground may be successfully employed as manure without previous conversion into superphosphate. The phosphate at present most used is 'Thomas's slag.' Phosphatic slag is of various qualities, containing 10-22 per cent. of phosphoric acid, with a considerable excess of lime. The soils most suitable for manures of this class are those rich in humus and poor in carbonate of calcium; these being the conditions (presence of humic and free carbonic acid) most favourable to the solution of phosphate of calcium. Moorland and pasture soils are especially suitable for such treatment. All undissolved phosphates must be employed in extremely fine powder. Good basic slag is generally sold with a guarantee that 80 per cent. of the powder shall pass through a sieve having 10,000 meshes in a square inch.

Agriculture and its Problems. We must remember that agricultural matters are not merely chemical problems. If they were so, we should simply have to look out for a soil with large proportions of the substances that plants require, and the matter would be ended. But agricultural work is a problem of great difficulty and great complexity. We

have to take into consideration not only the chemical composition of soils, but their mechanical texture; and not only as regards their power of allowing free percolation of water, but also on the ground of their acting as nurseries for various organisms— microscopic organisms and bacteria whose life history is solely aimed at the preparation of the constituents of the soil for the use of plants. Let me therefore impress upon you now that probably the mechanical condition of the soil is of greater importance to you agriculturally than its chemical composition.

Professor J.B. Harrison: " Lectures to Teachers."

Combustion in Plants. Now, if we examine a flower, if we take a long flower and plunge a thermometer into it, the temperature inside will be found to be some degrees higher than that of the air. This, of course, you cannot notice in ordinary short flowers, but you must use long tuberose-shaped ones. This higher temperature of flowers than of the air surrounding them is due to the fact that the tissues of the flowers instead of abstracting carbonic acid gas from the air and causing that carbonic acid gas to combine with water, and so on, so as to give rise to new products, are causing products already formed to combine with the oxygen of the air and be burnt up with the production of heat. We have already learnt in the course of our past lectures that under the influence of sunlight, the chlorophyll of the leaves splits up the air absorbed by the plant, retaining its carbonic acid gas. In flowers there is exactly the opposite process: the substances made in the plant are being broken to pieces and are combining with the oxygen of the air; and the flowers instead of abstracting carbonic acid gas are giving it off. The flower, then, is where combustion is taking place. This process is most marked in some large, brilliant coloured lilies.—*Ibid.*

Humus. The term " humus " is applied to the black or dark brown material of vegetable origin which gives to surface soil its characteristically darker colour as compared with the subsoil. It is essentially a product of bacterial action; there are a number of bacteria working in the absence of air and universally distributed, which attack the carbon compounds of plant tissues, especially the carbohydrates, with the production of marsh gas or hydrogen, carbonic acid and humus. In the presence of air the characteristic humus-forming fermentation is replaced by one which results in the complete combustion of the organic matter to carbonic acid. For this reason more humus is found in a pasture than in a continually aerated arable soil, more again in clays than

in the lighter soils through which air is always drawn as the rain perculates, and the accumulation of humus reaches its maximum where considerable rainfall and an impermeable stratum combine to make the soil so water-logged that all access of air is cut off, as in swamps and bogs. The presence of chalk in the soil also assists in the destruction of humus, since it neutralizes the acids which largely compose the humus, and which tend to inhibit the further action of bacteria...Although dark brown humic substances can be prepared from carbohydrates, and therefore contain only carbon, hydrogen, and oxygen, yet the organic matter of the soil, even when dissolved and reprecipitated, always contains some nitrogen, nor can it be obtained entirely free from phosphorus and mineral matter. The original vegetable matter is made up not only of carbohydrates, but of other carbon compounds containing nitrogen, and in some cases, both nitrogen and phosphorus; these all break down under bacterial action into dark-coloured substances richer in carbon and roughly classed as "humus". The splitting process continues in the soil, so that humus becomes one of the great sources of nitrogen for the food of plants, and a soil well supplied with humus is generally regarded as fertile... Humus acts as a weak cement and holds together the particles of soil, thus it serves best to bind a coarse-grained sandy soil, and, by forming aggregates of the finest particles, to render the texture of a clay soil more open. In determining the sizes of the constituent particles of a soil, the "mechanical analysis", it is desirable to remove humus as far as and so break up these temporary aggregates.

—A. D. Hall, F. R. S. "The Soil"

Farm Policy and Managment. One of the first and most important questions that confronts the agriculturist is to decide what kind of farming will give best results under his special local conditions. In making his decision he must consult not only his own preferences and abilities and his available capital, but the nature of his soil and climate and particularly the character and needs of his available markets and his transportation facilities. A certain amount of specialization is undoubtedly desirable.... In general, however, diversified farming is safer and more profitable and lends itself much more readily to a proper rotation of crops and the preservation of the fertility of the land. The average farmer should first and foremost see to it that he produces at home, so far as possible, everything that is consumed on the farm. Second, he should study the *possibilities of his local market* carefully and seek, as far as possible, to supply it. The man who produces the bulk of his own supplies and sells enough produce

to his neighbours to furnish his other necessities is assured of success, no matter what the state of the market for great staples... Neglected opportunities of this kind are to be found on every hand. Extensive observation in many regions gives convincing proof that very few towns and cities have a really adequate home supply of those products that could be easily produced in the neighbourhood ...The production of fruits and vegetables for distant shipment is a highly specialized line of agriculture, and as a rule should only be embarked in by those having some special knowledge of, or aptitude for, the business, In this industry proper transportation facilities are the very first desideratum. Suitable soil and climatic conditions must also be carefully considered as well as an available supply of labour A beginner in a new region will encounter many difficulties that would be already better solved for him at the recognized centres of the industry.

—F. S. Earle, "Southern Agriculture."

"Air Saltpetre."

In a paper by Professor Bernthsen, on the fixation of atmospheric nitrogen, read before the Seventh International Congress of Applied Chemistry, it is stated that considerable quantities of "air saltpetre" will shortly be put on the market, and that, probably, within a few years the annual output will reach 100,000 tons.

—The Agricultural News. (Barbados).

The Typhoid (or House) Fly.

The London "Lancet" says:—"The best exterminating agent is a weak solution of formaldehyde in water (say two tea spoonfuls to the pint), and this experience has been confirmed by others. It would appear that flies are attracted by a weak solution of formaldehyde, which they drink. Some die in the water, others get so far only as the immediate vicinity of the plate of water, but all ultimately succumb, and where they occur in large numbers hundreds may be swept from the floor. It is consoling to know that by this method the flies have, died under a dose of a fluid which is fatal to disease organisms, a fluid also which is inoffensive and for practical purposes non-poisonous. The method at once provides a method of diminishing the scourge and of securing to some extent what is most desirable—the disinfection of the slain.

Notice of Book Received.

"Handbook of British Guiana: 1909." Edited and compiled by Geo. D. Bayley.

Advance copies of the "Handbook of British Guiana, 1909," have been submitted to the Permanent Exhibitions Committee and it is understood that a limited number of copies will by this time be at the disposal of the general public. Certainly the Editor of the Handbook, Mr. G. D. Bayley, of the local Civil Service, is to be congratulated on the successful issue of a great deal of arduous and protracted labour. The volume bears internal evidence of much patient application and personal research, and displays, consequently, a real accuracy in matters of detail. Mr. Bayley has not been content to accept Blue Books as necessarily infallible; and to the stranger who is, or who intends to come, within our gates, the multitudinous items of fees, charges, licences, and regulations may be confidently recommended as reliable.

The Editor has, too, been fortunate in his contributors; for the articles which make up so large and important a part of the book are all written by local people who may fairly be regarded as authorities on their respective subjects. A very representative collection of photographs has been secured, and these illustrations, which range from the Brazilian border to Georgetown, from Roraima to the sugar estates, from Berbice to Morawhanna, must give the reader who is strange to these scenes, a very real idea of their true character. Particular mention must be made of the artistic quality of Mr. H. I. Perkins' work; many of his river scapes are delightful; while the most remote and secret corners of the colony have not escaped

THE RECORDING CAMERA

of the indefatigable Forest Officer, Mr. Wilgress Anderson, who also contributes a capable account of the geography and topography of the colony, and of the native "Buck Indians;" both of which he has had exceptional opportunities for studying.

It would be impossible in a brief review to deal in detail with each one of the long series of articles which gives "The Handbook" its comprehensive quality. The *Journal* is concerned primarily with matters agricultural; and in this respect the new Handbook is not lacking. The Director of Science and Agriculture is responsible for a concise summary of the local agricultural resources which is decidedly encouraging in tone. Thus

with reference to bananas, Professor Harrison writes: "Probably the most promising of the colony's undeveloped agricultural resources is the cultivation of bananas. There are few, if any, places better suited, from soil and meteorological conditions, and from the topography of the land with its system of natural and artificial waterways, than are the coast-lands of British Guiana for the cultivation of this fruit. The bananas grown in the colony are of large size and of excellent flavour.

" If facilities are provided for the rapid transport of the fruit from the colony and for placing them on the market, there can be little doubt that a great impetus will be given to the cultivation of bananas in the colony, and that in the course of a few years British Guiana will become one of the leading places in the world for the exportation of the fruit; unfortunately, at present, lack of satisfactory means of transport to the consuming countries makes this impossible."

Such an opinion, coming from such a quarter, is

OF THE HAPPIEST IMPORT.

Sugar— with a special reference to the cane experiments— rice, cacao, coffee, coconuts, cotton, citrus and other fruits, rubber and pastoral industries are all touched upon, and the remarks made on each are brief but very much to the point, and are well worth the careful perusal of those interested.

Professor Harrison also contributes the chapter on the general geology of the colony, of which his knowledge is of course unique. Here special attention is paid to the practical aspect of the subject and the gold-miner's point of view. This article, again, is one which no intending mining visitor can afford to overlook.

For the rest Mr. Bayley may well be satisfied with having formulated, as it were, a standard Handbook for British Guiana; one which may be revised and brought up-to-date as occasion shall require. The only thing about the volume which must lead to any hostile criticism is its awkward shape and size. The illustrations unfortunately are arranged—badly—and the coloured cover could easily be improved upon.

Visits to Country Districts.

The following places and districts have been visited by the Director and other officers of the Department of Science and Agriculture since July last:—

Pomeroon.

The Senior Agricultural Instructor visited the Pomeroon in connection with the proposed site for an experiment station for that district. Terms have been made with Mr. A. A. Thorne, F.R., to lease some 10 acres of land from his grant, Covent Garden, near Marlborough. It is intended to establish a station of mixed products, such as rubber, coffee, limes, etc.

Bonasika.

The forest reserve has been visited by the Forestry Officer and the Senior Agricultural Instructor. A landing has been erected, and also a small benab. Tapping experiments with Sapium rubber have been commenced, and it is expected the results will be of interest. Many young seedlings have been collected and are at present in the Nurseries at the Botanic Gardens. They should be available for planting out in about two or three months time.

Onderneeming.

The Industrial School Farm and the Suddie Prison Farm have been inspected by the Assistant Director. The prospects for the cacao crop appear to be good. Fourteen of the best trees have been picked out and marked for the purpose of seed for the Nurseries at the Botanic Gardens. They are of the Criollo and the Forastero types. A market stall has been established in the Model Garden to encourage the sale of small quantities of economic plants to small growers. This stall will be fed from the Botanic Gardens, Georgetown, and from the Onderneeming School nursery. The Assistant Gardener has visited Onderneeming for the purpose of grafting nutmegs and oranges.

Christianburg.

This station has been visited by the Senior Agricultural Instructor. Hevea and Sapium rubbers appear to be growing fairly satisfactorily, and more plants will shortly be put in. The teak is also growing well.

Penal Settlement and District.

The Penal Settlement farm was thoroughly inspected by the Agricultural Superintendent, and the land proposed to be used in connection with the agricultural side of the Borstal system for youthful offenders was reported upon. The lime cultivation at Agatash has made marked progress since the last visit. The trees are healthy

and vigorous and scale insects have been successfully kept under control by spraying with Rosin compound.

Canal District.

Canal No.1 has been visited by the Assistant Director and the Agricultural Superintendent. A certain number of farms were visited and many points of interest noted. Some of the coffee trees are dying from a root disease. This is being investigated and it is hoped that successful remedial measures can be devised. In a large number of cases, it is caused by faulty drainage.

Agricultural Shows.

The Director and other officers of the Department were present at the Agricultural Shows held at Buxton and at La Grange, West Bank. The Assistant Gardener advised the growers of the Buxton district as to the best methods of putting up their exhibits and the Junior Agricultural Instructor was assigned to the West Bank district. The Buxton exhibits were not quite up to their usual standard. The show at La Grange was, as usual, a credit to the district. It showed that the farmers were taking a keen interest in agricultural matters.

Berbice Gardens.

These Gardens have been inspected by the Assistant Director and the Head Gardener. A plant shed has been erected to house the plants belonging to the Gardens and those for the stall in the Market at New Amsterdam.

Estates.

Plantation Vryheid was visited by the Assistant Director and the Agricultural Superintendent in connection with cacao cultivation. The cultivation on this property is being improved and proper drainage is being put in, while an effort is being made to fight the 'witch-broom' disease. The experiments conducted in Surinam in connection with this disease indicate that it can be successfully controlled. Lopping attacked trees and spraying with 4 per cent. solution of copper sulphate have given good results; and it has been established that the cost of the treatment, taking in account also the loss of one crop, has more than paid for itself in three years. These experiments should greatly encourage any planter whose property is affected with 'witch-broom', and they should be carefully studied. They were reviewed in the Journal of the Board of Agriculture, Vol. 2, No. 4.

Plantation Enmore was visited by the Assistant Director to investigate the extent of damage being done by the large moth borer (*Castina licus*) of the sugar-cane. The life-history of this day-flying moth has not yet been fully and satisfactorily worked out, and in view of this incomplete knowledge, the estate authorities are doing all they can for its control. It is hoped to thoroughly investigate this pest at an early date as reports indicate that it is becoming more prevalent on the East Coast estates.

F. A. STOCKDALE.

The Result of "Boycing."

In the early part of the year there was a good deal of malaria in the (Coolie) lines asthere was in other parts of Singapore at the time, and on the return of the Director steps were at once taken to remedy this ; the secondary scrub round the lines, which was swarming with mosquitos was cut down and destroyed, and all tins, broken pots, and other breeding grounds removed, the mud drains from the lines bricked and the place generally cleaned up : *and the fever immediately disappeared, there being no more cases.*—[The italic are ours.—ED.]

—Annual Report for the year 1908, Botanic Gardens, Singapore.

Food Value of Sweet Potatoes.

The food value of the sweet potato will be seen from the following comparative analyses.

100 lbs. of sweet potatoes contain :—

Water	69·32 to 73.11%
Ash	1·09 to 1·29
Protein (*i.e.*, flesh forming material)	1·38 to 2·47
Fibre	0.86 to 1·23
Nitrogen free extract (starch, sugar, gum, etc.) ...	29·73 to 28·46
Fat	0·43 to 0·85

As a matter of comparison, it may be said that 100 lb. maize contain 89· 1 dry matter, 10· 5 of protein, and 75 lb. nitrogen free extract ; while 300 lb. sweet potatoes contain 86. 7 lb. dry matter, 4.5 lb protein and 75. 3 lb. nitrogen free extract.

—Q. A. J., July 09.

Reports on Local Shows.

Two local Agricultural Shows were held during the quarter; at Buxton on August 24, under the auspices of the Buxton and Friendship Farming Association, and at La Grange, West Bank, on September 1, by the West Bank Farmers' Association.

The former was opened by Mr. J. Wood Davis, F. R., in the unavoidable absence of His Excellency the acting Governor (the Hon. C. T. Cox, C.M.G.) and the Militia Band was in attendance. The large number of visitors testified to the popularity of the Show.

The Head Gardener of the Botanic Garden (Mr. J. F. Waby) reported officially as follows: "I fear it must be admitted that this year's Show is not an improvement on previous ones. There were some good exhibits but for the greater part they were only fair. In numbers almost all round they were less, and as to quality I do not think the judges could have had much difficulty. The staging was fairly well done, being carried out under Mr. Greeves' supervision. The Show Committee, being quite new to the work, should be grateful to him for his instructions all through. The Board of Agriculture sent 111 fruit and economic plants, of which 76 were staged in pyramidal form."

The La Grange Show was interfered with by a heavy storm of thunder and rain which occurred shortly before the opening. That function consisted of a short address by the Secretary of the Association and a brief but forcible and felicitous speech by the Director of Science and Agriculture. The proceedings were enlivened by music from a local Band, which was much appreciated. Mr. Waby's report read:—

" Each year the West Bank is improving in its show. The fruits generally were very good: the bananas, the best exhibited for years. The citrus fruit were in good quantities. The oranges, both sweet and Seville, were good. Neither mangoes nor guavas were in season, so nothing much was expected of these. The avocado pears were not good; of bread-fruits only a few were really good; coconuts on the whole were good. Of vegetables, the ordinary plantains were excellent. All the roots were good—better tannias could not have been grown. Pumpkins were smaller than usual, but were good fruits. In Economics, coffee, and cacao were splendid samples. The meals, starches, etc.

were in quantity and of good quality. The bottle section was weak. Castor and coconut oils were few, but were very clear. The poultry and live stock were very poor. The school gardens were represented by five baskets only, but the model gardens had some nice bright exhibits, of which tomatoes were exceedingly good."

"The exhibits of the Board of Agriculture were similar to those at Buxton, and were arranged in the same manner on the usual pyramidal staging."

Demonstrations to Small Farmers.

One of the most interesting steps taken by the United States Department of Agriculture for the improvement of agriculture is what is known as the Farmers' Co-operative Demonstration Work, which places a practical object-lesson before the smaller farmers with the view of illustrating the best and most profitable methods of producing crops. It has been developed chiefly in the southern portions of the United States, where education, wages, profits and rural conditions generally are on a lower plane than other parts of the Republic.

Active work commences in October by calling public meetings in each district at which the advantages of improved methods are explained. Demonstration plots are arranged on the farms of men who will agree to follow instructions in such a way as to admit of every farmer in the neighbourhood seeing one or more of them during the season. Each month instructions are sent to every demonstrator and co-operator, clearly outlining the plan for managing the crops (chiefly cotton; maize, tobacco) and, in addition, a local agent calls each month to explain anything not understood in the instructions. All the co-operating farmers are invited to meet the State agent at one of the demonstrations plots with the view of discussing the methods, and it has been found that those meetings have been wonderfully effective in arousing local interest. A circular setting out the fundamental requirements of good farming is sent out in advance to provide a good basis for discussion.

It is regarded as of the greatest importance to confine the work to a few leading crops, and the instruction to the basic methods and principles which lead to the best results, and to repeat this line of instruction until every farmer knows the methods that make for success. The demonstration work appears to have been remarkably successful not merely in improving the crop yields, but indirectly through the increased earnings resulting therefrom, in bettering the conditions of rural life.

—Journal, Board of Agriculture (England).

Districts Assigned to Agricultural Instructors.

The Director of Science and Agriculture has assigned the following districts to the officers mentioned :—

Berbice River West Coast, Berbice	A. L. MANSFIELD.
Upper East Coast Lower East Coast	A. A. ABRAHAMS.
Lower East Coast West Bank, Dem. River	FITZ GREEVES.
Issoroora Rubber Station and North Western District	W. H. MATTHEWS.

It has been found in the past that a considerable amount of the Instructors' time has been practically wasted by visiting farmers and others, and finding them absent from their holdings. It has been thought, therefore, that if arrangements can be made with the village authorities, that farmers and others desirous of obtaining the assistance of an agricultural instructor might make their wants known through them. Forms of application have been drawn up, and arrangements are now in hand between the Department of Science and Agriculture and the Local Government Board, whereby it is hoped that these application forms may be filed at the village offices, so that any farmer can readily obtain them. These have only to be filled in and forwarded to the Assistant Director of Science and Agriculture, Botanic Gardens, and the Instructor next visiting the district will undertake to visit the cultivations as desired. Similarly forms of application for visits to school gardens have been drawn up. These can be obtained by any teacher through the Education Department.

The Agricultural Instructors are sent into the country districts to assist the farmers in any of their difficulties and to instruct them as to the most progressive methods of cultivation. Unless the farmers meet these Instructors upon their land and unless application is made for their services from time to time, it is impossible for the Department fully to comprehend the particular difficulties and wants of the different districts of the colony, but it is hoped that by an arrangement whereby the village authorities act as intermediaries between the farmers and the Department, the services of the Agricultural Instructors will be sought for much more frequently than at present.

The Model Gardens.

Record of Attendances.

Below is given a table setting out the number of pupils who attended the Model Gardens of the colony, arranged in quarterly periods from April 1, 1907:—

	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Total Attendances.
1907								
April 1 to June 30	305	337	412	329	12	...	...	1,395
July 1 to Sept. 30	381	298	202	285	256	...	...	1,422
Oct. 1 to Dec. 31	575	293	380	221	288	...	...	1,757
1908.								
Jan. 1 to Mar. 31	597	731	389	299	187	...	...	2,203
April 1 to June 30	1,438	860	183	274	243	...	...	2,998
July 1 to Sept. 30	1,698	976	440	199	212	...	...	3,525
Oct. 1 to Dec. 31	1,714	819	465	115*	411†	160‡	...	3,684
1909.								
Jan. 1 to Mar. 31	1,638	710	338	463	370	302	...	3,821
April 1 to June 30	1,707	677	329	142	288	446	...	3,589
July 1 to Sep. 30¶	2,252	742	433	436	172	378	223‖	4,636

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during the instruction given by the Superintendent Teacher. It has not yet been found feasible to keep a record of the many attendances during his absence.

---

* School in vacation November and December.
† Vacation in December.
‡ Instruction commenced in November.
¶ Schools in vacation during August.
‖ Instruction commenced in July.

Board of Agriculture.

The quarterly meeting of the Board of Agriculture, held on Wednesday, October 6, was less formal than usual; the members foregathering at the office at the entrance to the Botanic Gardens and making an inspection of the nursery, the model kitchen garden, the Brickdam experimental plots and the larger experimental fields "aback." Professor Harrison and Mr. Stockdale piloted the visitors round and explained to them the progress and the object of the various experiments.

Among those present were the Hons. B. Howell Jones and C. P. Gaskin, Messrs. J. Wood Davis, F. R., J. Junor and J. Monkhouse, and the Rev. F. C. Glasgow; and certainly they seemed most interested. In the nursery there were *Sapium* and *Hevea* seedlings and the *Robusta* coffee from the Congo a heavy bearer of good flavoured, if small berries. In the Brickdam beds were the cotton hybridization experiments by which it is hoped to establish a strain of plants combining the resistant power of the local cottons with the long-stapled lint of the Sea Island varieties. Incidentally the work shows promise of making some contribution to Mendelian literature, after a few more years experiments have been carried on. The soil in the Brickdam field is not noted for its quality, and in the middle of a very dry season, it did not look even its best. Some of the cane-seedlings especially were evidently suffering from the weather. Nevertheless the conditions and soil are very similar to those found in abandoned sugar estates, and it is this circumstance which lends so much importance to the rubber experiments now in hand there. *Sapium, Hevea, Manihot and Funtumia* are all represented; and without going into detail it may be stated that *Sapium*, in the Georgetown district, does not do nearly so well as in the North-West. On the stiff clay lands of the coast the tree tends to become

SHRUBBY IN HABIT

and attacked by scale. This tendency is marked in the specimens growing aback of the rice plots belonging to the Department, where, by-the bye, further interesting and valuable rubber experiments are in progress, and may be seen in its fullest development in the original *Sapium* tree planted by the late Mr. Jenman in the avenue of the Botanic Garden.

Green " smother " crops and bananas concluded the sights in the Brickdam plots, and the visitors proceeded in carriages " aback." There they found six acres under different varieties of rice, and experiments in progress to ascertain the best kinds for seed purposes. It was observed also that single stools of rice were tied up in muslin bags. These were carefully selected heads and will be the basis for selection experiments during the next year. Near the overseer's house in the experimental fields is a trench in which the paddy recently sent from India (see Note in this number of the *Journal*) had been planted out and was springing famously. A run through the sugar-cane variety and manurial plots and a glimpse at the twenty-six varieties of bananas in cultivation by the Department and refreshments brought an instructive afternoon to a close.

An Instructive Test.

As regards the colouring of milk, the point raised was tested (at the Lincoln Show) by asking those who were watching the proceedings in the dairy to give their opinion on milk of various shades. The experiment apparently demonstrated what it was intended to do, viz., that the general public judge milk by its colour. It is pointed out that to colour the paler milks so as to pass them off for the milks richer in fat is a practice that cannot be commended. Experiments of a similar nature were carried out with butter. In every case the pale butters were voted the worst, the deepest in colour being always preferred.—Journal, Board of Agriculture (England), March,1909.

An Effective Locust Spray.

" Other pests reported on include locusts, of which a small swarm of fliers passed over Empangeni on 26th February, and of which Forester Garland destroyed six swarms of hoppers at Springvale, near Ixopo, during the month with a spray of arsenite of soda and sugar supplied by the Government Entomologist. Forester Garland describes the effect of the Government formula as deadly to the plague in the hopper stage. Report of Chief Officer of Natal.—

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to October 13, 1909. The corresponding figures for the two previous years are added for convenience of comparison :

Product.	Jan-Oct, '07.	Jan-Oct, '08.	Jan-Oct.'09.
Sugar, tons.	55,654	59,624	6[illegible],002
Rum, gallons.	1,129,445	1,203,635	1,322,195
Molasses, casks.	372	164	426
Cattle-food, tons.	5,206	3,727	5,799
Cacao, cwts.	592	885	533
Citrate of Lime, cwts.	3	13	49
Coconuts, thousands.	313	152	450
Copra, cwts.	..	..	423
Coffee, cwts.	2	57	1,120
Cotton, lbs.	63	..	..
Fruit, brls. and crates.	3	50	1
Ground Provisions, vlaue.	$2,318.58	$1,765.06	$ 216.32
Kola nuts, cwts.	32	..	38
Rice, tons.	2,154	2,712	3,741
Rice-meal, tons.	196	1,937	1,448
Starch, cwts.	27	..	..
Cattle, head.	944	1,241	789
Hides, No.	3,625	2,979	2,549
Pigs, No	418	585	708
Poultry, value.	$377.06	$229.72	$184.20
Sheep, head	162	32	53
Balata, cwts.	6,778	6,521	5,647
Charcoal, bags.	64,908	59,166	61, 772
Firewood, Wallaba, &c., tons.	4,723	5,670	6,709
Gums, lbs.	4,079	854	6,512
Lumber, feet.	43,384	45,248	175,622
Railway sleepers, No.	4,000	1,000	2,500
Rubber, cwts.	37	40	45
Shingles, thousands.	1,302	2,291	1,332
Timber, cubic feet.	192,954	157,333	212,066

Answers to Correspondents.

Mahaicony.—The weevil affecting your sweet potatos, is *Cylas formicarius*, a pest that is not uncommon in Jamaica and the southern United States. All affected potatos must be cleared up and buried at least two feet deep with lime, and potatos should not be planted on the same land for at least eighteen months.

H. L. P.—The only variety of banana generally acceptable in the American market is the Gros Michel or Jamaica banana, but there is a small (practically negligible) demand for the claret varieties. The dwarf or Chinese variety is the favourite on the English market and is sent in quantities from the Canaries packed in crates in cotton-wool. A decided attempt has, during the past two or three years, been made to introduce the Jamaica banana into European markets (see page 75 of this *Journal*).

L. A. R. —Coconuts must have good drainage. Unless drainage is carefully attended to, they will not thrive, and they will commence to die. Excess of water at the roots, through lack of drainage, will produce symptoms very similar to those frequently described as being peculiar to "bud-rot." "Bud-rot" is far too often held to be an excuse for bad drainage.

H. D.—Your bread-fruits have been attacked by a fungus. Some of those at the Botanic Gardens have been similarly affected and the disease is being investigated. Most probably Bordeaux mixture will satisfactorily control it. A report on this disease will appear later.

Georgetown.—Your *Impatiens* is affected by a fungus—a species of *Colletotrichum*. This can easily be controlled by spraying with Bordeaux mixture.

North-West. —Your Sapiums are affected with Black scale (*Lecanium nigrum.*) If they be in any number they should be sprayed with Rosin compound (see page 69 of this *Journal.*) A knapsack sprayer is sufficient for young trees, but for larger trees a more complete outfit will be necessary.

Demerara River. —The specimen you submit is witch-broom. It should be cut out from the estate, and should on no account be allowed to remain or otherwise it may rapidly spread. Cutting back (lopping) of the cacao trees and spraying with a 4 per cent. solu-

tion of copper sulphate has given satisfactory results in Surinam and is now being tried in this colony.

Surinam.—The practice of Jamaica is to sever the banana suckers from the parent bulbs with a cutlass. We believe that a shovel is more handy, and cannot but think that simply cutting the suckers at the level of the ground is a waste of time and money.

C.P.—Your collection of weeds will gladly be named for you if you will send them to the Herbarium. If it is a large collection it may take some time to name them all.

Demerara River.—Robusta coffee came originally from the Congo. It is largely cultivated in Java and is being experimented with in Surinam. The berries are small, but the yield is good. A brief article on this coffee will appear in the next *Journal*. A good quantity of the plants will shortly be available at the Botanic Gardens.

A. Fields (Berbice).—Your maize plant was affected with Smut *Ustilago maydis*). Let us know promptly if more cases occur in your garden.

The Progress of Khartoum.

"The article on the Sanitation of Khartoum (in the Third Report of the Welcome Research Laboratories) is worth reading by all Municipal Commissioners in the tropics, and the story of the conversion of Khartoum from a filthy, stinking, malarious spot into a decent, clean, comparatively healthy town, is one of no small interest. In this part of the work some experiments are detailed of the use of *Derris uliginosa* as a larvicide for mosquitos. This climber is an extremely common and rather pretty plant with pale pink pea-flowers... It is allied to the well-known Tuba root, and was found to be very effective in killing mosquito larvae: a decoction of the bark being used... It might be possible to make an extract of these barks which could be used as a larvicide in parts of the world where the plants themselves could not grow."

—Agricultural Bulletin, Straits and Federated Malay States, July, 1909

Selected Contents of Periodicals.

Thumb-nail Pruning and Disease.
The Loranthus Parasite.
Tropical Agriculturist (Ceylon), August, 1909.
Cultivation of the Pea-nut.
Queensland Agricultural Journal, June 1909.
The Problem of our unproductive Lands.
The Orange in Eastern Spain.
Some Facts concerning Maize.
Journal Department Agriculture, Victoria (Australia) vol. VII.
Pumping and Irrigation.
The Manuring of Fruit-trees and Vines.
Agricultural Journal, Cape of Good Hope, August, 1909.
Wild Ipecacuanha and its effect on Cattle.
Animal Pests of Cotton.
Agricultural News, Barbados. August and September, 1909.
Bacterial Flora of Hawaiian Sugars.
The Hawaiian Planters' Monthly, June, 1909.
Agricultural Education in England and Wales.
Root-pruning Fruit Trees.
Journal, Board of Agriculture (England) July and Sept., 1909.
Central Factories.
The Scarabee of the Sweet Potato.
West Indian Bulletin, Vol. X., No. 2, 1909.
The Erosion of Land.
Colonial Office Journal, July, 1909.
Researches on Jamaica and Artificial Rums.
The International Sugar Journal, Sept., 1909.
Rat Virus in Jamaica.
Proc. Agric. Soc., Trinidad and Tobago, Sept., 1909.
Windbreaks.
Porto Rico Horticultural News, Sept., 1909.

Forwarding Diseased Specimens for Examination.

In a former number of the Journal (Vol. i., pp. 53-5) hints were given as to the preparation, packing, and transmission of Specimens to the Government Botanist's office, but it is thought advisable to bring forward again the most essential points, for the guidance of those who have not the former article available.

(1.) A few fragments of a diseased plant are of practically no value for a scientific investigation. Sufficient material should always be sent, so that the primary cause of the trouble may be located.

(2.) Full particulars should be given as to the nature and extent of the damage done, the part of the plant attacked, the nature of the soil, drainage, the prevalence of the disease, when it was first noticed, and whether any similar kind of disease had been previously observed in the neighbourhood.

PACKING.

(3.) Specimens of portions of plants attacked by fungi may be sent green if packed in a well-ventilated box if the time taken for delivery is under 24 hours, but if delivery takes a longer time all leaves or soft fruits should be placed in a bottle or corked tube containing a solution made of 1 part of rum or methylated spirit and 2 parts of water. As many stages of the disease as possible should be sent, with notes as to the nature of each stage.

(4.) Living insects should always be packed with a supply of the plant on which they were found feeding, and the box should have some small holes pierced for purposes of ventilation. These should be carefully packed in such a way as to prevent their becoming crushed in transit.

(5.) Hard-bodied insects such as beetles, grasshoppers, bees, etc., may be killed by immersing in boiling water for about half a minute. They should be allowed to dry, be wrapped loosely in soft paper, each insect in a separate piece, and then packed in a strong box.

(6.) Butterflies and moths should be killed in a poison jar or by squeezing the body below the insertion of the wings. They must be handled carefully to prevent injury. Butterflies should have their wings folded back to back and each specimen separately folded in paper, while moths may be wrapped loosely in tissue paper.

(7.) All soft-bodied insects such as grubs, worms, plant-lice, etc., should be sent in small bottles preserved in diluted rum or other spirit.

FORWARDING.

All specimens should be accompanied with detailed particulars of the nature of the disease and should be addressed to :—

THE GOVERNMENT BOTANIST,
Botanic Gardens,
Georgetown

THE JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL. III. JANUARY, 1910. No. 3.

Some Local Aspects of Co-operation.

A noteworthy feature of the close of the year 1909 was the revival in this colony of the spirit of co-operation. A real effort seemed to be made among those whom we may, without offence, call the "small men" of British Guiana to combine for purposes of mutual benefit and more especially of agricultural advancement. A local company was formed, co-operative banks on the small scale were established, and in many other ways evidence was given that the right spirit was abroad. The results of these praiseworthy efforts are yet to be seen, but whatever their fate, the fact that they have been made must be counted to the people for righteousness. As consistent advocates of Co-operation, we welcome the movement; and we would call attention to at least one serious attempt already made elsewhere (but in our neighbourhood) in that direction and endeavour to draw a lesson which may have an important bearing on local policy. We refer to the Land Settlement Scheme which was devised for St. Vincent—a plan which has now been long enough in operation for some definite conclusions to be drawn from it.

Mr. F. A. Stockdale, in an instructive minute to the Board of Agriculture, recounts that after the hurricane of 1897, the Government of St. Vincent undertook the settlement of the ruined peasants on the land. Small holdings were formed on some thirteen estates in different parts of the island, and an agricultural instructor was appointed by the Imperial Department of Agriculture whose whole time was devoted to visiting the allotments, instructing the allottees on the best manner of growing their crops and of preparing them for export. Provisions and arrowroot were the chief crops grown, but with a view of enabling the holders to establish cultivations of a

permanent character economic plants were distributed free of charge from the Botanic Station and their cultivation was carried out under the advice and personal supervision of the Agricultural Instructor and the Agricultural Superintendent. The area of the allotments varied from 1 acre to 7½ acres, and the principal economics grown were cacao, coffee, oranges and rubber. At the end of 1907 there were over 60,000 cacao trees established on some 584 allotments and the total estimated production of cured cacao for the year 1906-07 was 53 bags, of which 48 were exported. A thorough inspection of all the allotments was made in 1904, and again in 1907 and it was estimated, in the latter year, that 36,402 cacao trees had "improved," 13,272 were in "fair" condition, while 20,436 were "poor."

Since that minute was written, the report on the scheme for 1908-09 has come to hand and the remarks made by Mr. G. Fraser, the agricultural instructor engaged to look after the allotments—and the allottees—will repay careful consideration. Thus of the Linley Valley estates he says: "Cacao continues to do well, but the cultivations had to be followed up closely as the allottees were inclined to be very neglectful, especially in the matter of pruning. . . Allotments in this valley continue to improve generally. Allottees are now doing a little better with the planting of pigeon peas for green dressings and are burying all the grass and bush available to improve their lands. Manure in the form of compost heaps continues to be made. Mulching has been adopted by a few allottees. They will soon see the benefit of it, and I hope their action will be an example to others." In Cumberland Valley "the cultivation of economic plants, ground provisions, canes and cassava was fairly well done. The planting of pigeon peas and other catch crops for green dressing purposes was advised, but allottees are inclined to be very neglectful unless constantly reminded." Clare Valley and Questelles holders were disappointed at the prices realized for arrowroot but ground provisions gave very good returns, the prices received in the local market being satisfactory. "Allotments on the whole were well looked after, but some allottees were very neglectful in making up compost. The planting of pigeon peas for green dressing purposes was advised, but so far only a few allottees have taken advantage of the advice given." On Richmond Hill estate "Sea Island cotton was planted and fairly satisfactory results were obtained by allottees who paid strict attention to their cultivation." At New Aldelphi "the ground-nut crop was attacked by a caterpillar. Spraying with Paris green was advised but was not carried out. The crop did not turn out well:" while at Park Hill Mr.

Fraser gave direct instructions in reference to the improvement of the cultivations, and hoped, by example, to show those allottees who did not carry out instructions the folly of their neglect.

These brief extracts demonstrate remarkably clearly the inner workings of the scheme, and are very instructive. The poor prices realized for arrowroot confirm the comment by Mr. Stockdale that "to make it complete, an agency should have been established for the purchase or for the sale on commission of the produce." In England where experience of small holdings shows daily the absolute necessity for co-operation, people complain that they no longer receive the prices they formerly enjoyed owing to the competition arising out of the local extension of small holdings. Instead of this position becoming stronger by the advent of fellow-workers, each new recruit is merely one more added to the number who are cutting the throats of their neighbours. There is danger that this experience will be extended all over England if serious attention is not paid to the question of organizing the production and sale of produce on the thousands of newly-acquired holdings scattered about the country.* The other point brought out by Mr. Fraser's report is the inability of the allottees to stand alone. The instructor seems to have been busily employed in keeping his pupils up to the mark. and even so, his advice was not always acted upon. "Neglectful" is a word which occurs with depressing frequency, and it is evident that any relaxation of vigilance on the part of the supervisor would speedily result in the deterioration of the allotments and the probable degeneration of the allottees to the status of "squatters."

Of course it may be argued that these allottees of St. Vincent are hardly co-operative small-holders in the sense that natives of this colony anxious to engage in —let us say—banana cultivation would be ; they were settled on the land by the compulsion of a great disaster. We can gather, then, little information as to how they would behave if they had to obtain their holdings against competition and under the pressure of a real "land-hunger." In so far the lesson from St. Vincent is deficient. But the spirit which, we trust, would be shown may be illustrated from the Old Country in another quotation from Mrs. Wilkins. "It was particularly in the division of the land amongst the applicants that the benefit was felt on both sides in having it carried out by a Committee of

---

*Mrs. Roland Wilkins (L. Jebb) in "The Journal of the Board of Agriculture' (England), Vol. xvi, No. 5, August, 1909.

the (Agricultural Organization) Society than by an agent of the County Council. All the men had local knowledge of the conditions which required fulfilment, and were moreover, acquainted with one another's affairs. As each man was in a sense responsible for the rent of his neighbour, judgment was displayed as to the amount of land allotted to each one, having regard to his ability to pay or the likelihood of his cultivating the land in a satisfactory manner. A great spirit of fairness was shown in distributing this insufficient acreage amongst the would-be small holders, a task which it would have been almost impossible for an outsider not living on the spot to have carried out in such a satisfactory manner. In some cases lots had to be cast; several men withdrew in favour of those who had not yet had a chance of getting on to the land, and it was necessary to cut down the acquirements of many to a lower limit." Now in *race and character the St. Vincent peasants may be compared* to a large section of those of British Guiana, and two points at least may be emphasized for application here:—one the advisability of a well-conducted and intelligent agency for the disposal of the produce and the other the absolute necessity for a strong Board of Agriculture to advise, instruct, encourage and supervise those who would seek their fortune on the land.

More Light in Cow Houses.

Everybody admits the advantages, so far as health is concerned, of an out-door life, but just how much is due to fresh air and how much to the influence of sunlight it is difficult to say. Sunlight is, however, known to be one of the most powerful, as it is one of the cheapest germicides we possess; it therefore should be admitted freely into all buildings occupied by stock. It is a matter of indifference whether it comes from the walls cr roof, provided it is ample and does not fall directly on the eyes of the animals. Of all the details connected with cow-houses, few of them have received so little consideration as that of lighting. This omission has been in part due to the erroneous belief that stock fatten quicker in the dark than in the light; but in any case, nothing will contribute so much to cleanliness in the cow-house as plenty of light. It costs little, and its value there is great, if it were for nothing else but to afford an opportunity of seeing the dirt."

—Journal of the Board of Agriculture (England), October, 1909.

Notes.

Sisal and Soil. We would draw attention to a note in *The Agricultural Journal of India* for October, 1909, regarding the cultivation of fibre plants and especially to the remarks concerning the soil most suitable for *Agave*, which confirm in a striking manner the experience of, and the advice given by, the Department of Science and Agriculture in this colony. It used to be thought that *Agave* would grow and thrive on any soil and under any conditions of climate. In fact it was said that the worse the soil, the better the sisal, and enterprises have been started on the theory that *Agave rigida* var. *sisalana* would thrive on ground which was too poor to support any other kind of cultivation. Experience, however, has conclusively proved that the Agaves require good land for rapid growth and that for the latter a fairly heavy rainfall is required. Sisal hemp yields the largest and quickest returns under careful cultivation on good land in a moist climate.

Cultivation of Rubber Estates in the North-West District. A report recently forwarded by the Instructor in charge of the Experimental Rubber Station in the North-Western District emphasizes that the work of cutlassing down weeds and young undergrowth has been entirely suspended or has been most unsatisfactorily carried out on some of the rubber estates in that district. Some of the fields have been neglected for a considerable time and the rubber may almost be said to be in ' bush '. It is hoped that the practice of allowing weeds to grow and then cutlassing them down every three or four months as advocated in this *Journal* from time to time has not been construed to mean that rubber should be grown in bush. All undergrowth in rubber cultivations should always be vigorously kept down and all grass should be cutlassed every three or four months. The best results cannot be expected if the trees are allowed to become covered with vines or smothered with bush, and once these are allowed to overrun a plantation, diseases, both insect and fungus, are most likely to become prevalent. *It is of the utmost importance* that cutlassing of weeds and grass should be done at intervals of *not more than six months apart,* and that bush should be kept down *always.* No bush should be allowed to reach more than three to four feet in height at any time or otherwise the growth of the rubber is likely to be retarded and the time before tapping

can be commenced prolonged. The aim of every rubber estate must be to bring a fair area of evenly grown healthy trees to a stage when tapping may be commenced in the shortest possible time and in the most economical manner. Economy must never be the excuse for neglect, or otherwise it may soon be found by the cultivator that neglect is only *false economy*, as increased work has to be done at a later date and the returns will be poor. Work on a rubber estate must be just as regular as for any other cultivation, and it is to be regretted that estates which were looking so flourishing this time last year should of late have been somewhat neglected. It is pleasing to note, however, that a few cultivators are beginning to clear off their bush. This work should be pushed on as much as possible or otherwise the rubber will most probably suffer and expenses at a late date, when the bush will have to be cleared off, will be greatly increased.

Biliary Fever and Trypan Blau.

The Agricultural Department of Cambridge University, which has already made for itself a wonderful reputation in a short space of time, seems to have accomplished another triumph, this time in Veterinary Science. Professor Nuttall, working in conjunction with Dr. Hadwen of the Health of Animals Branch, Department of Agriculture, Canada, has discovered what promises to be an invaluable remedy for the disastrous disease known as biliary fever of dogs (canine piroplasmosis). This complaint, which is a veritable scourge in the Cape Peninsula and along the coastal area of Cape Colony and for some distance inland, has proved quite amenable to injections of "trypan blau," a recently discovered dye of the benzidine group, and the results of the experiments conducted in South Africa and published in the *Agricultural Journal of the Cape of Good Hope* are quite startling to read. Dogs normally doomed to die from the tick-carried disease recovered in a few days after a single injection of the drug, the dye seeming to act as a specific poison to the piroplasmata. The only ill-effect to the dog would appear to be a certain amount of local irritation and (occasionally) swelling at the seat of the puncture, and the staining blue of the animal. But even a blue dog is better than a dead one, and as the colouring wears off in time this would not appear to be any disadvantage. It is hoped that the dye will prove efficacious as a curative for certain other diseases of animals, such as "red water fever" of cattle. Experiments in this direction are already in progress, and the results will be watched with interest. Already the mild

English form of 'red-water' has been indicated as amenable to the treatment, but a local trial on the Onderneeming bull (which has been suffering from an obscure form of continued fever possibly caused by trypanosomes in the blood-stream) gave no definite result. In fact the bull eventually succumbed to the fever, which was not definitely diagnosed and seemed to baffle all the local talent.

Rubber Seedlings. One cannot help noticing the many turns and twists (abnormalities) that young plants of *Hevea brasiliensis* display. The frequence of 'knee-bends' and 'complete circles' in the seedlings raised at the Botanic Gardens last year had attracted attention, when a pamphlet issued by Mr. Petch, of the Botanical Department of Ceylon, dealing with this very subject was received. Mr. Petch showed how these 'abnormalities' arose and how far the method of planting the seed was responsible for them. The Para rubber seed is a slightly flattened ellipsoid, being rather larger at one end than at the other. One of the broad faces is slightly rounded and may be called the upper side, while the lower side is grooved down the middle. Along this groove lies an adherent strand which ends in a small depressed area. At the other end is the micropyle, which is easily seen by the thin covering over the hole where the young root comes through when the seed germinates. A number of seeds were sown in different ways to ascertain what proportion of 'twisted' seedlings resulted, and incidentally some information was gained—of importance to planters in this colony who are raising their own rubber seedlings—as to the method which is likely to give the most satisfactory results. The experiments were similar to those of Mr. Petch in Ceylon, and 1,000 seeds were sown in each of the following ways :

(a) Horizontally, with the lower side downwards—germination 66·1%.

(b) Horizontally, with the lower side uppermost—germination 63%.

(c) Horizontally, on the narrow sides, 65%.

(d) Vertically, with micropylar end downwards, 64.4%.

(e) Vertically, with micropylar end uppermost, 54·7%.

It will be noticed that the germination results were very similar in all the different methods tried, but considering the growth of the seedlings afterwards it may be generally accepted that the

sowing of the seeds horizontally with the lower side downwards is likely to give the most satisfactory results. Those seeds which were sown vertically with the micropylar end downwards were largely shot out above ground when germination had taken place, while those which were sown vertically with the micropylar end uppermost have shown, as was noted in Ceylon, a large proportion of seedlings with 'knee-bends' and with twists. These will be briefly discussed in the next number of the *Journal.*

A Point.

The only way to gain a profit in any business is to pay strict attention to the care of it. This applies more to poultry than to any other business.

—The Natal Agricultural Journal.

Fungi and Para Rubber.

"Many (*Hevea*) trees were lost through wound fungi which obtained an entrance through a wound made where a branch was broken off, or where a wound has been made in some other way. Most planters now recognize the danger of bare wounds and cover such with tar, but the practice is unfortunately far from universal."

—Annual Report for 1903 of Government Mycologist, F.M.S.

Public Opinion.

Every layman in the West Indies thinks himself competent to have an opinion and express it in print on technical matters of all kinds. And every unofficial is ready to condemn any action of a Government, even though it is of quite a special nature outside of common knowledge, and has been advised upon by experts. It is perhaps hard for people in Britain to understand this phase of West Indian thought and life. The man in the street in London does not trouble himself to criticise technical matters outside of public concern. He, as a rate-and-taxpayer, is employing special men to know, to advise, and to do; and he is satisfied that he is getting the best work for his money by letting experts do it . . . . The only remedies, perhaps, for the opposition of the (W.I.) public to progress are *time and the education* of public opinion.

—The late Dr. Branch in "The Colonial Office Journal."

The Experimental Error in Field Trials.

In the October number of this Journal we mentioned in our note on The Experimental Error in Field Trials that our experiments with Rice and with Cacao had not been carried on for sufficiently long periods of time for the possible errors to be calculated out with accuracy, and we did not therefore submit any figures with reference to them. But since writing the note it has become necessary for us to make certain calculations with regard to the possible error in our rice and cacao work, and we think it desirable to place the results on record rather than to leave them unpublished for a period of some years.

Rice Experiments.

We have records of six years experiments with varieties of rice, but the earlier series were not laid out, on account of the very restricted area and the small amounts of seed paddy then at our disposal, so that the possible and probable errors could be calculated. The first year for which this can be done is 1906 when comparisons were made with various forms of phosphate manuring. The varieties of rice which had been under cultivation for two or three years previously were planted on beds varying from one-thirtieth to one-fortieth acre each. In the case of those treated with phosphates the results may be summarised as follows :—

Phosphates used.	*No. of trials*	Deviation per cent. from mean in *Excess.*	*Deficit.*	*Probable error of mean.*
Slag	8	24.2	37.0	± 4.0 per cent
Basic Superphosphate ..	5	35.6	14.4	± 5.5 ,, ,,
Superphosphate	3	6.9	8.4	± 2.4 ,, ,,

Other varieties were in plots of less area than one sixtieth of an acre. In these cases the results may be summarised :—

Phosphates used.	*No. of trials.*	Deviation per cent. from mean in *Excess.*	*Deficit.*	*Probable error of mean.*
Slag	3	29.8	28.2	± 7.6 per cent
Basic Superphosphate ..	16	52.4	30.5	± 3.8 ,,
Superphosphate	17	22.7	38.6	± 2.0 ,, ,,

Clearly not only were the maximum errors of single plots, 37% in the series with the larger plots and 52.4% in those with the smaller plots far too high, but owing to the wide range of variations the probable errors of the mean yields of the plots were so high as to render unreliable any conclusions drawn as to the action of the manures. The range of possible errors from a few plots are more marked in the small plots than in the large ones, thus indicating that plots of less than one-sixtieth of an acre (5 square rods) are far too small on relatively new land to give, with rice, reliable results, even when carried out on many duplicate plots, whilst the wide range of variation with the plots of one-twentieth and one-fortieth of an acre each indicated that even these areas were under the special circumstances of the trials not as large as desirable.

The Director of Science and Agriculture was absent from the colony at the time of reaping these experiments and at that of replanting the land for the trials of 1907. The points indicated above were not noticed, or if noticed were not acted upon, and the trials for 1907 were arranged in a great number of small plots of about one-fiftieth of an acre each.

These enabled a series of 18 duplicate comparisons to be made, which showed on single plot results maximum deviations from the mean of the duplicate plot of 30.1% in excess and of 27.9% in deficit. The results also showed probable errors of about 13.7% from the mean of all comparisons if two of the plots were selected for comparison, of 10% if three were selected, of 6% if six were considered, 5% if eight were used, and of 4.0% if eleven were compared, with a mean probable error of about 1.5% if all of the thirty-six plots were taken into consideration. These results showed that one-fiftieth of an acre plots are too small to give reliable results within reasonable limits of probable error unless an excessive number of plots are employed.

A large number of the varieties of rice were withdrawn from cultivation in 1908, the experiments being re-arranged in the hope of reducing their liability to error. The areas of the plots were increased to from one-fifteenth to one-seventh of an acre each, and each trial repeated on at least three plots. The results obtained on twelve not-manured plots indicated that under this system in 1908 the possible error on a single plot was reduced to $\pm$ 7% whilst the probable error over the twelve plots was $\pm$ 1.6%

The trials in 1909 were carried out upon similar lines. In this year, the maximum possible error was on a single plot ± 8%, the mean probable error over the twelve unmanured control plots being 1.1%.

Our experience with rice shows that a satisfactory degree of accuracy in trials of varieties and of manures can be obtained by the use of plots from not less than one fifteenth to as much as one-sixth of an acre each, the manurial trials being in triplicate, and the variety trials extending over the series of several plots, the mean results of not less than eight but preferably of twelve plots being taken to represent the yield of a variety. The soil errors are thus eliminated to a very satisfactory degree on land where both irrigation and drainage are under thorough control and when the paddy used for seed is most carefully selected.

Cacao Experiments.

The trials with cacao at Onderneeming School Farm show that over a period of four years the possible maximum errors on single plots were 36% in excess and 27.6% in deficit of the mean yields of triplicate plots, the size of the plots being one-third of an acre and the mean number of bearing trees on each of them being 95. These results were deduced from the following, each of the mean yields of each series of three plots being taken as 100:—

	Yield % of mean.	*Probable error of mean result of ecah series.*
No manure, Plot 1	129	
,, 2	95.6	
,, 3	74.7	± 8.7 per cent
Nitrogen only.		
Plot 1	136	
,, 2	99.7	
,, 3	72.4	±10.1 per cent.
Potash and Phosphates.		
Plot 1	101.6	
,, 2	115.3	
,, 3	83.1	± 5.1 per cent.
Potash, Phosphates and Nitrogen		
Plot 1	115.5	
,, 2	108.	
,, 3	76.3	± 6.7 per cent

Hence over a period of four years the error on a single plot of approximately 100 cacao trees on absolutely flat, fairly well-drained land may amount to as much as 54%, whilst the probable error on the mean of three similarly treated plots may amount to ± 10.1 per cent.

The mean results of the various series of experiments when shown as percentages of increase on the mean yields of the unmanured plots were as follows:—

Plot Series.	*Mean increases on plots, yield of not manured taken as 100.*	*Probable error of mean result of each series.*
Not manured		± 8.7
Potash and Phosphates	6.2	± 5.1
Nitrogen	1.2	± 10.1
Nitrogen and Potash	8.7	± 8.5
Nitrogen and Phosphates ..	23.7	± 2.9
Potash, Phosphates and Nitrogen	8.7	± 6.7

As the excess yields to give reliable results must be more than twice the probable error on the not manured series together with the amount of the probable error on the series under consideration, it follows that only the series manured with nitrogen and phosphates gave increases sufficiently high to allow of any deductions being safely drawn; the other indicated increased yields being of about the same magnitude as, or less than, their own probable error.

The experiments were re-arranged in 1908 in the hope of reducing the probable error. It is not possible at present to state if we have been successful in this, but the possible error for a single plot for one year is still very high, being ±30% on one-third of an acre plots with approximately 95 trees, and ±55% on one-sixth of an acre plots, the mean probable error on a series of five similarly treated plots being about ±4% on the larger ones and varying on the smaller ones from ±6 to ± 8 per cent.

J. B. Harrison.

F. A. Stockdale.

December, 1909.

The Monetary Losses caused by Insects.

Nowhere has the economic aspect of insect life been so extensively and carefully studied as in the United States of America. The enterprising people of that vast country seem to have the habit of translating facts into dollars, of seizing on the financial aspect of problems, of commuting generalities into hard cash ; and when we have to consider, from the practical side, the harm done to mankind by insects, it is to the United States that we naturally turn for much that is latest and best in the literature of the subject. Not that other nations have done nothing. Of late years the matter has forced itself upon the attention of all civilized peoples ; but the West, with her readiness to seize upon and appreciate and exploit to the full all new ideas, has distanced the rest. Nowhere do we find established so wide reaching and active a Bureau of Entomology as in the States and her dependencies, and nowhere else are the results obtained so generously advertised and so quickly grasped and acted upon. If, then, we rely for many of our facts for this article mainly on American sources, we are not without some justification.

Losses from injurious insects are very great, and many of them could be greatly reduced by the adoption of measures of control now well-known. It is estimated that insect injuries amount to at least

ONE TENTH OF THE AVERAGE CROP

annually, which would be something like six or seven hundred millions of dollars for the United States during each of the past few years (1905 to 1907.) The Codlin moth, which is now practically world-wide in its distribution, accounts for half the crop of apples.[1] All the various kinds of crops, and crops in all stages of growth pay their tribute. Cereals suffer from the time the seed is planted till the harvested grain is stored, or even after mill products have been distributed to dealers and consumers. Fruits suffer in root stem or trunk, branch, bud, leaf and fruit. Domestic animals are annoyed, preyed upon, or their substance consumed, and both domestic animals and man are subject to inoculation with deadly diseases through the agency of insect pests. These losses are distinctly an economic waste, and like losses from fire and flood present little in the way of compensating advantage. Even if

1. Theobald.: ' Agricultural Entomology."

2. Quoted from "Economic Zoology" by Prof. H. Osborn, M.Sc. (Macmillan, 1909).

the increased price for a depleted crop helps one section at the expense of another, the total result is a loss to the community at large.[2]

At the outset we come into contact with the order of magnitude of the figures with which we have to deal. As in geological time, the million appears to be the unit. The insects in the matter of individuals can only be computed in millions, and the damage they do is reckoned on the same colossal scale. In the year 1881, in the island of Cyprus, 1,300 tons of locust eggs were collected and destroyed. In the year 1891, damage to the extent of £20,000 was done to root-crops in Great Britain alone. Miss Ormerod calculated that the losses on cattle from the attacks of warble-flies in England amount to

£7,000,000 PER ANNUM.[3]

Osborn has computed that on an acre of pasture there exist, as a rule, about a million of hoppers (of the family *Jassidæ*) and that they obtain quite as large a share of the food as the Vertebrates feeding with them.[4] He reckons the loss to orchards in New York, Ohio, Illinois and others States through the Codlin moth at millions of dollars.[5] It is difficult for the human mind to comprehend the significance of such stupendous figures as these; but if we accept Professor Osborn's estimate of the annual loss to the United States by insect pests, it means that, could the money be saved and distributed in the capital of the county of Demerara, it would take the form of an income of $60,000 to each family; while £1,000,000 a year, distributed as a present, would give every Christmas each man, woman and child in Georgetown, British Guiana, $100 "to burn."[6] As for the numbers of insects and their rates of increase, it is sufficient to quote Huxley's well-known estimate that the produce of a single *Aphis* or "green fly" (a tiny insect pest common enough in Georgetown just now) would in the course of ten generations, supposing all the individuals to survive, contain more ponderable substance than five hundred millions of stout men; that is, more than the whole population of China. "It has since been contended," says Mr. Sharp[7] "that Professor Huxley's calculation was much below the mark." Similar considerations apply to the Hessian fly, the Colorado beetle,

3. Theobald: "Agricultural Entomology."

4. Quoted by Sharp in "Cambridge Natural History" Vol. VI.

5. "Economic Zoology" Osborn p. 278.

6. The population of Georgetown is taken at 50,000 and the average number of persons per family at five.

7. Cambridge Natural History, Vol. VI p. 89.

the Phylloxera of the French vines, the cotton-boll weevil of Texas and many other insect pests, of which the individuals must *be reckoned in myriads and the damage they do counted in millions* of money. No figures are available to give us any idea of the pecuniary loss caused by the caterpillar pest of our coconuts (*Brassolis sophorœ*), by the many pests of local economic plants, and now especially by the large moth borer of the sugar cane (*Castnia licus*); but we may be sure that they would confirm the experience of the rest of the world.

When we come to regard the steady strain on the resources of mankind by insect borne diseases it is more difficult to express the results in definite figures, and to embody in concrete form the enormous losses involved. The financial loss to the United States by the one yellow-fever epidemic of 1878 was estimated as

AMOUNTING TO $15,333,000!

But suffering, panic, fear and the tears of widows and orphans can never be estimated.[8] The epidemic of 1853 cost New Orleans 8,000 lives; that of 1793 wiped out 10 per cent. of Philadelphia's population. Now the death rate is perhaps the most insignificant feature of the devastation which yellow fever epidemics have produced. The disease once discovered in epidemic form, the whole country has become alarmed; commerce in the affected region has come virtually to a standstill; cities have been practically deserted; people have died from exposure in camping out in the highlands; rigid quarantines have been established; innocent persons have been shot while trying to pass those quarantine lines; all industry for the time has ceased. The commerce of the Southern States of America during the epidemic of 1878, for example, fell off 90 per cent., and the hardships of the population cannot be expressed in monetary terms. The effect of a yellow fever summer in the South has been felt not only all over the United States, but in many other portions of the world.[9] Yet the death rate on occasion has been appalling enough. During the French attempt to dig the Panama Canal, three of the medical staff died from yellow fever in one day, and in the same month nine of the same medical staff succumbed. Thirty-six Roman Catholic sisters were brought over as nurses, and twenty-four

8. Dr. W. D. McCaw in "Annual Report of the Smithsonian Institute" 1905, p. 556.
9. Quoted from Dr. L. O. Howard; Bulletin No. 78 (Revised) Bureau of Entomology 1909.

died of yellow fever. On one vessel, eighteen young French engineers came over, and in a month after their arrival

ALL BUT ONE DIED.[10]

In 1847 during a severe epidemic in Georgetown, British Guiana, Surgeon General Blair wrote that in a few months 69 per cent. of all the white troops had perished.[10] How can the true inwardness of such facts as these be expressed in mere figures, however striking they be made?

From an agricultural point of view, perhaps the greatest loss is in the reduced value of real estate in mosquito infected regions that and (as Professor Harrison puts it) the loss insects inflict on the agriculturist as carriers of malaria, filaria and possibly of other diseases to him, thus depriving him of a considerable number of his working days and, by converting him into a "tired man," lessening the value of his exertions on the days he is able to work. Insects render uninhabitable large areas of land otherwise suitable for suburban homes, for summer resorts, for manufacturing purpose and for agricultural pursuits. The development of the State of New Jersey has been held back by the mosquito plague. Of the Delta region of the Mississippi, the second best farming land of the world, Herrick says, "this land to-day, or at least much of it can be bought at $10 to $20 an acre. . . Wby is not this land thickly settled? And why is it not worth from $200 to $500 an acre? If it produces from one to two or more bales of cotton to an acre, and it does, it ought to be worth the abovementioned figures. . . . Land that will produce a net profit of $40 to $80 an acre is a splendid investment at $100, $2C0 or even $300 an acre. Yet this land does not sell in the market for anything like so much, because the demand is not sufficient, for white people positively object to living in the Delta on account of

MALARIAL CHILLS AND FEVERS.

The only reason that thousands do not go there to buy lands and make homes is on account of chills and fevers. But there is a time coming, and that not far distant, when malaria in the Delta will not menace the would-be inhabitants. When that time comes it will be the richest and most populous region on the United States."[12] That this optimism is not unjustified may be seen from what Dr. A H. Doby, Health Officer of the Port of New York,

10. Howard *op. cit.* p. 22.

11. Boyce: "Mosquito or Man." John Murray, 19J?.

12. Quoted by Howard; *loc cit.* p. 14.

has already accomplished on Staten Island. The inhabitants of the place at first resented the worthy doctor's efforts to exterminate mosquitoes : to-day they are talking of erecting a monument to him. He has rid them entirely of the striped-legged mosquito, the savage *Culex sollicitans* that, besides driving away one cannot compute how many potential residents has hitherto made life a burden during the summer months ; and he has all but annihilated the *Anopheles*, its malaria-carrying relative. The conquest of the mosquito has increased the value of real estate on the island by hundreds of thousands of dollars ; new houses are going up throughout its length and breadth, and residences that have long been inhabited only by caretakers are being rented. Further, in the overthrow of the mosquito there have been reclaimed something like 7,500 acres of the best kind of land for market gardening, previously of so little value that its owners had never taken the trouble to ascertain their boundary lines ...., the entire cost to the City (of Richmond) amounting to considerably under $50,000.

But we must not allow enthusiasm for the subject to lead us from the point. It is not the aim of this short article to discuss preventive means and methods of cure. Still we cannot refrain from mentioning that in the town of Klang, Malay Peninsula, where modern ideas of mosquito eradication were intelligently put into practice in 1901, the sick leave rate of Government officers was reduced to one-twenty-fourth in the course of three years. In 1901, 176 Government officers had a total of sick leave amounting to 1,026 days, whilst in 1904, 251 had only 71 days sick leave.[14] It is such results as these which prove even to the general taxpayer (who ultimately pays the salaries of Government officials) that the game is worth the candle.

ALLEYNE LEECHMAN.

---

13. "Harper's Magazine,' July 31, 1909.
14. "Laboratory Studies in Tropical Medicine" (Daniels).

Rats in Rice-fields.

"It is now satisfactorily demonstrated that carbon bisulphide is a cheap, simple and effective method of getting rid of rats in padi (paddy) fields."

—W. J. Gallagher (Government Mycologist) in Agric. Bull. F.M.S., Vol. VIII., No. 9.

The Large Moth Borer of Sugar-Cane,

(*Castnia licus*).

During the latter part of 1909, visits were made at the request of certain estate authorities on the East Coast to investigate the damage that was being done to sugar-cane by the Large Moth Borer (*Castnia licus*) and to see the different remedial measures that were being given a trial.

This insect, which came to be recognised as a serious pest to the sugar-cane in this colony in 1904, has been investigated by the Board of Agriculture in this colony, by the entomologist of the Imperial Department of Agriculture for the West Indies, and by the entomologist of the Board of Agriculture of Trinidad, but it was recognised that our knowledge of its life history and of remedial measures for its control was still wanting in many respects, and that it seemed desirable that it should be thoroughly investigated on the spot. The Director of Science and Agriculture suggested to certain estate authorities that an entomologist should be engaged to work its life history out on the estates and to carry out experiments with remedial measures. He stated that he thought that if the services of Mr. J. J. Quelch, B.Sc., who was for sometime the Curator of the Museum of the Royal Agricultural and Commercial Society, could be procured for a sufficiently long period of time, a thorough investigation could be made, for it was felt that Mr. Quelch's knowledge of the fauna of this colony would enable him to make progress more quickly than an entomologist not conversant with the fauna and the conditions prevailing in the colony. It was realised that no satisfactory investigation could be made unless it were carried on for a considerable period of time on the estate itself, so that natural conditions could be carefully studied. Mr. Quelch arrived in the colony on January 6th and immediately proceeded to take up his headquarters at Pln. Non Pareil, and as his brief report at the meeting of the Board of Agriculture given on page 174 will show, he commenced active investigations immediately.

The larva of *Castnia licus* causes the damage to the canes by boring in the cane itself and eating the internal tissues as it works its way upwards. Many of the canes die out, while others which have great tunnels in the central portions can only give very poor returns of sugar when they go through the factory. On some estates where this pest is common the returns from some fields badly

affected have been very poor, and in one or two years its presence has occasioned heavy losses.

SYSTEMATIC POSITION.

Castnia licus is a day-flying moth, and has some characters resembling butterflies and others resembling moths. It was thought originally to be a butterfly closely allied to the *Hesperidæ*, but Westwood in his monograph on the genus fully discusses the question and points out that Linnaeus and other writers of the eighteenth century placed the insects among butterflies under *Papilio* on account of the clubbed character of the antennæ. Fabricius and Latreille established the genus *Castnia*, which the former placed amongst butterflies and the latter between the *Hesperidæ* and *Sphingidæ*. Westwood held that the insects of the genus *Castnia* resembled butterflies in the structure of their antennæ and in their day-flying habits only, but stated that when the antennæ are carefully examined this connection is seen to be very remote. The genus is now placed at the head of the *Heterocera, i.e.*, amongst the moths.

FOOD PLANTS OF CASTNIAS.

Castnia licus has been reported from Ecuador, Trinidad, Cayenne, Surinam, Demerara, Para, the Amazon and the upper Orinoco. Its larvæ have been reported to feed upon plants of the orders *Orchidaceæ* and *Bromeliaceæ*, and upon sugar-cane and plantains in British Guiana, upon sugar-cane, bananas, and coconuts in Trinidad, while Mr. Quelch has taken this insect feeding upon the wild plantain (*Helicornia acuminata*) so common in the bush of this colony and especially on the back dams of the sugar estates.

EGGS.

The eggs are pinkish or greyish in colour. They are spindle shaped and have five longitudinal ribs running from end to end. They are reported to be laid singly in captivity, but it is not definitely known yet where there are laid in the field. Colonel Lushington found eggs deposited upon the cut surfaces of cane stumps, while eggs have been found in Trinidad at the base of cane plants and at the base of banana suckers, while a coolie employed at Pln. Enmore in catching the moths stated that eggs were laid in the axes of the leaves at the base of the cane plant.

Eggs laid in captivity have been observed to hatch in three or four days.

LARVÆ.

The larvæ or grubs appear to enter the canes from their bases and to eat their way upwards to from 12 inches to 24 inches from the ground. They fill their tunnels with cane chips and excrement, but when they are fully grown they are usually found in the root-stock of the cane and it is most probable that they may turn in their tunnels to proceed downwards into the root-stock to pupate. A few canes have been found in which the larvæ entered fairly high up, and worked their way downwards. Not more than one larva is found in a cane, and it is possible that one larva is capable of tunnelling through all the canes of a stool and even of proceeding underground from one stool to another, but frequently several larvæ are found in a single stool. The length of the larval stage is not known. A full grown larva is about 2½ inches long and nearly ½ inch in diameter. The head is reddish brown in colour. The larva itself is white, but just before it pupates it turns to a slaty black colour.

PUPÆ.

The pupæ are found in the underground portion of the cane and some have been observed to make earthern cocoons below the cane stool. The cocoon is usually made of cane chips bound together by fairly strong silken threads. It has been noticed that a considerable number of pupæ are to be found in the growing canes at the base of the young autumn shoots, and a very large number of the young shoots found to be dying or dead have been observed to have either a larva or a pupa at their base. In cut canes, Colonel Lushington observed that the pupa works its way up from the root stock through the tunnel by means of fringes of spines, preparatory to emergence of the adult. Mr. Collens observed in Trinidad that the duration of the pupal stage was 49 days.

THE ADULT.

The adult measures from 3 to 3¼inches across the wings. It is of a dull dark-brown colour. The forewing has a broad white band running across it about mid way and a smaller white band outside this running about half way across. The hind wing has a white band running obliquely across it near the middle, and along the outer margin are six orange yellow dots of fair size. The head is large and of a dark brown colour while the antennæ are slender and clubbed. The colour of the body is dark brown above and somewhat lighter below.

The adult flies in the day time; generally in or immediately round the cane fields and is generally supposed to be more numerous in light, warm weather immediately after canes are cut than at other times. The manager of one estate says that during warm weather the greatest number of moths are caught within 3 or 4 days of the field being cleared of cane, while in cold wet weather they do not emerge until some time later.

REMEDIES.

The following remedies have been tried and the results reported have been as here indicated:—

(1) Covering stumps with lime—result *nil*.

(2) Covering borer holes with clay after the canes have been cut—a partial success at first, but now given up as useless.

(3) Pouring poisons in borer holes—result *nil*.

(4) Pouring potassium cyanide over stools after the canes have been cut—result *nil*.

(5) Digging out the withered stumps and soaking them in water in punts for 24 hours—fairly satisfactory.

(6) Catching moths with nets—good results have been obtained, enormous numbers of moths having been caught.

(7) Submerging worst fields for 48—72 hours with water by means of a centrifugal pump erected in a punt—the results have been fairly satisfactory. The borers are killed by this method, but several pupæ have been found to be alive after the treatment. One estate has spent large sums on this method of control.

(8) Lights placed in fields—no record of results obtained.

(9) Sweetened baits tried in fields—no results obtained.

SUGGESTIONS.

After estates on the East Coast had been visited, a circular was issued by the Board of Agriculture to all estates in the colony asking whether this pest had been observed in the cane fields, what damage it was doing and what remedies were being tried. Answer to these enquiries elicited the information that the pest was prevalent on certain estates of the East Coast, and that it was not unknown in other districts of the colony and was occasioning some damage on certain estates. It was thought that experiments should be commenced to investigate the life history of the pest thoroughly, and the following memorandum was drawn up for the

use of those estates that wished to co-operate with the Board of Agriculture in obtaining preliminary information :—

For the purpose of these experiments, it is suggested that cages covered with ¼. in wire mesh should be built over some badly infested canes. In these cages accurate observations should be made, say thrice daily, by one of the estate authorities who might have an intelligent coolie to act as his assistant and to remain at the cages when the observer was absent.

Three cages thus covered would be sufficient to commence with :—Two small ones, say 8 feet x 6 feet x 5 feet, sufficiently wide to take in two rows of canes and two or three stumps in each row. These cages should be placed over the stumps immediately after the fields have been cut, and daily notes made, especially in regard to details relative to the questions enumerated below. As the canes grow, the "hard" canes should be cut out and examined for the stages of growth of the larvæ.

One cage should be large, say 10 feet x 10 feet x 12 feet, to allow of canes to be grown inside the cage through the whole year, so that observations may be made throughout a whole season. This should give some information as to how many broods of adults are produced each year, and at what intervals.

For the control of this insect, it appears to be absolutely essential that some information should be obtained in regard to parasites and natural enemies. It would seem most probable that the eggs or the adults are the most likly to be parasitized. It is necessary to find out whether the borer in canes has any parasites. For this purpose, two cages of the size of the smaller ones given above should be made of mosquito wire or muslin, and in one cage observations should be carefully made as to all the insects that appear from infected stumps. Every insect that does appear should be caught, killed in a small insect killing bottle, and kept, with notes as to the date of appearance, etc., for future reference. If many of the same kind emerge they should be watched and their habits recorded, but all insects caught should be kept for identification, in order to ascertain whether they belong to parasitic groups or not.

Into the other cage, all eggs collected in the field should be placed and a record kept as to whether any parasite appears from these eggs.

So far, no information has been obtained in regard to any parasites of this insect, but from the nature of its attack on canes, it would appear that parasites offer a most promising field for investigation, and one which is of prime importance for the control of the pest.

If no parasites are found on the insect affecting sugar-cane, it will then be necessary to find out whether the insect exists in any numbers in other parts of the colony feeding on other food plants, and whether parasites can be obtained from such insects to introduce amongst those on the estates.

Accurate observations are required on the following points :—

(a) At what time of the year do the adults lay their eggs? This might be ascertained by opening females caught by the coolies throughout the year.

(b) How long elapses after the adults emerge, before the eggs are laid?

(c) Where are the eggs laid?

(*d*) How many eggs are laid by one female, and how long does it take her to lay them ?

(*e*) How long do the eggs take to hatch ?

(*f*) How long elapses before the young larvæ enter the canes ?

(*g*) Where do the larvæ enter the canes ?

(*h*) Do they proceed upwards or downwards, or in both directions ?

(*i*) How long is the larval stage, *i. e.*, before larvæ pupate ?

(*j*) Where are the pupæ most generally found ? (a) In the old canes (b) in the stumps.

(*k*) How long is the pupal stage ?

(*l*) How do the adults emerge ?

(*m*) What happens after the adults emerge ?

(*n*) Are the adults attracted by any baits ?

(*o*) Are there any parasites or natural enemies of the eggs ?

(*p*) Are there any parasites or natural enemies other than "Old-witch" birds and kiskadees, of the adults ?

(*q*) What plants other than sugar-cane are these borers found in ?

It was realized that only an investigation carried on over a fair length of time could give such information as would be of real value for the purpose of controlling this pest, and that additional remedial measure would have to be experimented with and the results carefully watched. With Mr. Quelch actively engaged on Plantations on the East Coast, it is expected that our information with regard to this pest of sugar cane will be greatly added to in the near future.

F. A. STOCKDALE.

Controlling the "Gum-tree Scale"

The insect, *Eriococcus coriaceus*, first made its appearance in New Zealand about eight years ago, in the Blue Gum plantation at Timaru, whence it spread rapidly. As a remedy the Division of Biology introduced three species of lady-birds (parasitic on scale insects). Of these, *Rhizobius ventralis* alone throve well, and was distributed on a large scale from central breeding stations. This action has been so successful that the scale insect has practically disappeared in the neighbourhood of Timaru, and its spread has been effectively checked throughout the whole affected area.

—Bulletin of the Imperial Institute, Vol. VII., No. 3, 1909.

Rubber Cultivation in " Pat " Soil.

In many parts of the Malay Peninsula, usually in the vicinity of large tidal rivers, we find a somewhat peculiar soil formation popularly known here as " peat " formation."* It consists exclusively of dead timber roots and decayed leaves, to a depth sometimes of as much as twenty feet. Often no trace of clay, stone or other mineral matter is to be seen in it. The formation appears even if deep to be of comparatively modern date, geologically speaking. Before being cleared for planting it is seen to be covered with dense wet forests, in which grow a number of somewhat peculiar or local plants mixed with many trees which also occur on more ordinary soil. A characteristic tree is the Kempas (*Cumpassia malaccensis*) ; abundant too is the well-known red-stemmed palm (*Cyrtostachys lacca*) and the ground is often covered with an abundance of gingers (*Scitamineae*) and ground orchids. Walking through these woods one often sinks deeply into a mass of wet decaying leaves, over and through which lie the great roots of the big trees. Below this great mass of decaying vegetation is usually a greasy blue clay lying at various depths and apparently mainly old mangrove mud and over which this forest has gradually grown. When felled and burnt this so-called peat, after a period of exposure, commences to shrink, the surface of the ground often soon falling a foot or more. The exposed surface wood decays and forms at last a brown powdery soil, mixed with fragments of sticks, etc., and reminding one of the surface of an old tan yard. The water which fills the drains and streams from this formation is dark brown, resembling the brown peaty water of a Scotch moor, but is by no means safe to drink though it has only a slight peaty flavour as it is apt to produce a violent diarrhœa and has been known to cause much sickness of this nature among the coolies working on such land.

We have not seen any analysis of either water or soil from such ground, but it is probable that it contains an excess of humic acid and also of salts of magnesia, sodium, and potash.

Not long ago I visited the fibre plantations of the Peneiro estate in Southern Johore, recently floated as a company. Here *Sansevieria, Agave sisalana* and *Foucrroya gigantea* were being cultivated on a large scale for fibre making. I was much

*(This would seem to correspond very closely with the "pegass" soils of British Guiana— ED. *J. B. of A.*

struck with the appearance of the sisal hemp, (*Agave sisalana*). This plant long in cultivation in the Botanic Gardens in Singapore has never really made good growth, though being a desert plant, such as is scientifically called a *xerophyte*, it had been planted in the driest corners of the Gardens.

In this mass of decaying logs and branches it was growing luxuriantly. The plants were strong and healthy, in fact quite handsome and throwing up suckers in every direction—the suckers growing wherever they happened to be thrown. *Fourcroya* and *Sansevieria*, which, however, are much easier plants to grow here, were also doing well. One would not indeed have been prepared to find a xerophytic plant, cultivated successfully in dry sandy places in the West Indian Islands, thriving in a peaty, damp locality. On exactly similar ground I have seen Para rubber planted on a large scale. Now Para rubber is a typical *hygrophyte*, that is to say, a plant adopted for growth in the wettest regions of the tropics, the region known as the ' Tropical Rain-forest Region."

For a short time the little rubber plants looked all right, but only for a very short time. The mortality was frightful. The dead ones were replaced in vain. The plants all looked sickly and died, some from attacks of *Fomes*, others perhaps from termites, some from unknown fungi. The dead plants which were pulled up were remarkable for their very long tap root and for the fact that all the roots descended vertically parallel to the tap root. As every planter knows, the Para rubber is a high rooter, throwing its roots out horizontally over a large area. Here the roots were descending vertically as if seeking to reach the clay bed which underlay the peat at a considerable depth. Where the clay came near the surface the plants undoubtedly did better, but a depth of 12 feet or even less of the vegetable debris was fatal to them.

It has been shown lately by experiment that a wet swamp of peaty soil,—that is one with an excess of vegetable matter—is not *hygrophytic* but *xerophytic* and that the plants naturally found there are specially adapted for drought, that is to say a shortage of waater.

The reason for this is that these peaty soils contain in their water an excess of humic acid. This acid has so deleterious an effect on the protoplasm of the plants not specially adapted for growth in such soils that the water which should be taken up by the roots is actually poisonous and cannot be used by them at all. In fact, it has much the same effect as sea-water.

Nothing could be more unsuitable for the *Hevea*, whih requires a lot of water and requires it good. Plants in soil such as this become weak and very soon succumb to the attacks of fungus. They have no strength to resist any disease. In any case they could never make healthy trees even if there was no fungus about. In ground of this nature I have recently heard of a mortality of 100 per cent., and that the area planted has had to be entirely abandoned. In many parts of the Peninsula there are still left considerable areas of similar soil to this I have described, and planters would do well to avoid this ground entirely for rubber planting.

In Warming's "Oecology of Plants" he deals in Chapter 84 with the formations in acid soils, but his observations are only made on those of cold climates. Formations like those of our so-called peat-formations occurring in the tropics seem to be rare, and no records have been made of them. The action of these soils on plants is, however, practically the same as in temperate swamps, the main difference being that in the tropics the soil is composed of branches and trunks of large trees, while in temperate regions it is composed of smaller plants, bog-mosses, grasses and heaths. In the temperate regions a specially adapted flora has been produced to meet the demands of the peculiar soil, but in our limited areas, which seem to be of very modern age, there cannot be said to be a *xerophytic* flora developed from this soil formation as yet.

The factors which would go to make these soils xerophytic, although one would naturally suppose them to be hygrophytic, are given as follows :—

One of the factors is an increase in *transpiration,* that is to say the plants exhale a greater quantity of water than they can afford, and even marsh plants specially adapted to grow in such localities may be forced to reduce their transpiration. *Wet soil is cold and therefore physiologically dry.* We have no record of the temperature of these peat soils here, but this factor may affect the growth of rubber in such spots. *Respiration is obstructed* (the soil being poor in oxygen) and the functional activity of the roots depressed. This is a serious factor, and that this is of the greatest impo tance to plants is shown by the occurrence of aerating roots to trees in the wet, swampy, peat woods of the (Malay) peninsula. Many of those who have had to walk through such spots must have noticed the *knees* or projecting roots of certain t.ees rising a foot or more above ground in the form of cones. They are most abundant in the mangrove mud where the supply of oxygen is very small,

but they are often very conspicuous and striking in the wet swamp woods of the interior. Their presence shows conclusively that there is not sufficient oxygen in the soil for the plants growing there. Again " Livingstone arrives at the conclusion that at least in some bog-water there occur chemical substances which are not in the direct relation to the acidity of the water but which act on the vegetation, and it is suggested that these substances may play an important rôle in the inhibition from bogs of plants other than these exhibiting xerophytic adaptations " (Warming.)

The most important factor, or as Warming expresses it " the weightiest cause of the physiological dryness of the soil lies in the humic acid and other dissolved substances which chemically affect the roots. Humous acids depress the roots' activity and render it more difficult for the plant to replace the water lost by transpiration."

It may be pointed out, too, that these lands where this soil formation occurs are quite flat and consequently fully exposed to winds when cleared of forest for planting. In fact, one feels the wind sweeping through the cleared ground and sees the seedling rubber plants bending and quivering before it. Now wind has more than one injurious effect on young plants exposed to it. Constantly moving the stem of a young plant, it keeps it loose in the soil and breaks the rootlets and root hairs as they grow, so checking the growth of the plant. But wind also does more. It increases the loss of water by transpiration. The loss of water would be sufficiently bad if the plants were protected from wind, but when by clearing the forest the loss is increased by the exposure to the action of the wind, what chance has a hygrophytic plant like Para rubber of existing? The injurious action of wind in inc easing the loss of water has been overlooked—or not realized—by planters who bare every hill-top overlooking the estate to plant more rubber on it instead of leaving wind-belts to check this loss of water in the young plants. It is probable that this loss of water by transpiration is the cause of the peculiar wrinkled appearance of rubber leaves that one so constantly sees in wind-swept young plants, but this requires further investigation. *Hevea brasiliensis* possesses none of the adaptations for living in a dry xerophytic region. Plants adapted for such a region are often protected from excessive loss of water by having the lower leaf surface covered with wax or hairs, by having a thick cuticle to the leaves by having narrow leaves or leaves so arranged as to present the narrowest surface to the air and in various other ways. The

leaves of Para rubber are thin, neither protected by hair or wax they are broad and flat, so as to get the freest transpiration in their normal habitat,—dense, damp, shady forest. By planting them on ground where the transpiration or loss of water is excessive, as in these peat lands, we submit them to the same state of affiairs as if we planted them in the desert. When we add to this the insufficiency of oxygen in such soils, and the action of the humous acids and other chemical substances which injure the root and prevent its taking up water in sufficient quantity to replace that lost by transpiration, we can easily see that no plant of the type of *Hevea* can thrive or exist even for any time under such circumstances, strong and adaptable as the plant appears to be in those regions.

Peat-land, after being felled and exposed for a long time to the air, and drained, so that much of the humous acids are washed out of the soil, might (if not too deep above the underlying clays), in time become a good and suitable soil for growing Para rubber in, but it would not be worth while to go to this expense and long delay.

—H. N. Ridley, M.A., F.R.S., Director of Botanic Gardens, Straits Settlements. in "Agricultural Bulletin, S.S. and F. M. S." Oct. and Nov., 1909.

Newly-hatched Chicks.

Avoid feeding the little chicks until 48 hours old.

Give fresh water aud grit before food, and let the first meal be not more than they will pick up in five minutes including the learning how to eat.

Five times a day for meals, and five minutes at a meal, should be the rule for the first two weeks. Then lessen to four and soon to three meals daily. Clean the feeding board after every meal, and if milk is given the dish must be cleaned and scalded daily.

Charcoal kept in the drinking water will help to ward off indigestion.

Sunshine is good medicine, but if it is excessively hot some shade should be provided. The chick will readily adjust themselves to the proper temperature if given a chance.

Good grass in pleasant weather is the best place for the chicks.

—The Natal Agricultural Journal, Vol. XIII, No. 2.

"Lectures on India Rubber.*"

The above is the title of the official account of the proceedings of the Conference held in connexion with the International Rubber and Allied Trades Exhibition held in London in September, 1908, and contains the papers read at the meetings of that body by well-known authorities on rubber matters, brought together under the editorship of Dr. D. Spence. The information supplied is of the greatest value, and a copy should be procured by everyone interested in rubber. The lectures embrace the Brazilian rubber industry, rubber cultivation and manufacture in the East; the Mexican rubber industry, the rubber industry of the West Indies, and deals with many problems in cultivation, tapping, coagulation and manufacture of the greatest interest.

For those interested in rubber in this colony, the following brief notes made while reading through the pages of this book will convey some of the points of particular importance to us, and will indicate how the experience gained in other countries and set forward in the various lectures and discussions may prove of value to rubber interests here.

CHOICE OF LAND.

Under this heading may be discussed the conditions under which the Para rubber-tree (*Hevea brasiliensis*) grows most satisfactorily. In Brazil, the largest rubber-producing areas are located on the lower parts of the rivers which are subject to periodic inundations, but some very first-class rubber is obtained from higher lands where there is no inundation but only very heavy rains; but it is not thought that the elevation of these regions can be very high, as Manãos, which is 960 miles up the Amazon River, is only 80 feet above the sea level, and the rubber districts mainly exist between Manãos and the sea-board. On the numerous islands in the Amazon the *Hevea* lives on very low land which is daily submerged by the tides. The best trees are always found on peculiar "clay-reefs" or "banks" which are well-known to the rubber collectors. These "clay-reefs" are always looked for, as the best results are always obtained from them. The rainfall of the rubber districts vary from 80-120 inches and there is no prolonged dry season. The average temperature is about 80° F.

*"Lectures on India Rubber," edited by D. Spence. Publishers: The International Rubber and Allied Trades Exhibition Ltd., Chancery Lane, London, Price 10s. 6d. net.

In Ceylon, it is stated that a continuous dry wind, combined with prolonged dry weather, is the greatest enemy to the Para rubber tree. The early growth is generally slow, and later frequent leaf-fall takes place and the root pressure is reduced—consequently smaller yields result. For determining the suitability, or otherwise, of a district for rubber cultivation it is now generally recognised that more depends upon the temperature and upon the actual number of wet days than on the actual rainfall. In Malaya, the best growth is on well drained alluvial soil, and it is stated that a height of 12 feet or a girth of 4½ to 5 inches is not uncommon in a year's growth from stumps. The rubber tree apparently requires a continuous supply of moisture to the surface roots. In the majority of the clay soils in the East, the roots principally occupied the surface soil to a depth of one or two inches, but where drainage was good the roots sank deeper. Stagnant water must never be allowed to accumulate or otherwise poor results will be obtained as rubber aequires fresh water and in most cases it will be almost impossible to establish rubber trees in swampy land economically. In the earliest days of rubber cultivation, stress was laid upon the moist conditions under which the tree thrived in Brazil, and hence it was regarded that swampy and wet lands were necessary for good growth. In Ceylon, the first plantings were made in periodically flooded land, and they soon died. The rubber plant for good growth requires good drainage, a point which was emphasized by Mr. A. A. Wickham in his early reports, when he was Commissioner for the introduction of the Para Rubber Trade for the Government of India, but these reports appear to have been either inaccessible or overlooked, and much experience has been bought at ruinous figures.

The necessity for a constant supply of moisture to the roots naturally leads us to the various methods of

CULTIVATION

because the flow of latex depends very largely, if not entirely, upon the root pressure, and to obtain the maximum root pressure the soil must be in such a condition that the trees can readily absorb moisture and the humus content of the soil must be increased to the utmost. The question of clean weeding *versus* cover-crops was brought forward by Messrs. Bamber & Carruthers, but readers may be referred to the article on the "Treatment of Weeds in Permanent Crops" in number four of Volume II of this *Journal* for a general discussion of this subject. The general opinion of planters in the East is beginning to favour the cover-crop system, as thereby

the land is kept warm and moist and drainage is assisted to a certain degree by transpiration. Catch crops in young rubber are also common, as they shade the ground and keep down noxious weeds. A reduction of weeding means a considerable reduction of expenses, as on clean weeded estates the cost of the weeding has been as much as 70% of the total cost of the labour on the estate.

The question of

DISTANCES FOR PLANTING

was dealt with by Mr. Herbert Wright, but opinions seem to vary, as some hold that rubber planting should be considered from a forestry rather than from an agricultural point of view, while others hold that good returns have been obtained from estates planted 10 ft. x 10 ft. The richer the land the wider should be the planting, and it is generally considered that land that is so poor that 10ft. by 10 ft. is ample for the trees, could never grow rubber as a commercial undertaking. The distance of 20 ft. by 20 ft. is becoming fairly general, while 30 ft. by 15 ft. is being adopted by many, and it is stated that for those who are prepared to wait for large returns 30 ft. x 30 ft. could not be considered too great. It is emphasized that the point to be continually borne in mind is that "the value of a rubber estate is not determined alone by the number of trees but by the available bark for tapping and the recuperative power of the trees."

TAPPING.

At the Conference a good deal of discussion took place as to the relative values of the "incision" method as practised in Brazil as opposed in the "excision" method common throughout the East.

Mr. N. H. Witt informed the Conference that tapping commenced on the higher rivers in Brazil in May and in the lower parts in July and August. The collectors select paths in the forests containing about 100 trees as a rule. Single incisions are made with a small axe and cups put under them. The cups are fastened on the tree at a distance of 1 or 2 feet from one another and the next day the cups are put about 4 inches below or above those of the previous day, according as to whether tapping is commenced at a height of six feet from the ground or at the base of the tree. The trees are tapped about 90 to 120 days in the year. During rainy days the collectors do not work, and careful proprietors suspend tapping operations during the dry season. Some proprietors also allow no tapping to be done during the time of flowering. Within 24 hours after a shower of rain the collectors get an increase in the flow of latex rich in rubber but if the rainfall continues the

percentage of rubber instead of being about forty would be as low as 10 per cent. and Mr. Bamber said that the rubber content of the latex often comes down to 10 per cent. if tapping is too severe, Therefore tapping on alternate days is to be advocated rather than tapping every day.

Before tapping is commenced in Brazil, many of the collectors gash the trees 3 feet above the tapping areas as they say that the full amount of latex can only then be obtained, and it is stated that this matter is going to be carefully investigated in Ceylon.

In the East, the half-herring-bone "excision" method is the one usually adopted. Tapping commences in the 5th or 6th year after planting, when trees have reached a girth of 20 inches at 3 feet from the ground. The cuts of the half herring-bone are made 1 foot apart, thereby allowing 1 inch of bark to be removed each month, and as tapping is done every other day, 15 or 16 cuts are made to the inch. Renewed bark cannot be tapped for three or four years as it does not yield a satisfactory percentage of rubber and therefore the tapping area of the tree must be divided into three or four parts, *i.e.*, $\frac{1}{3}$ or $\frac{1}{4}$ of the circumference is tapped each year. Frequently the secondary bark acquires a thickness equal to that of the original bark before the latex is sufficiently concentrated, and therefore if permanency of output is desired this secondary bark must not be tapped too soon, or irreparable damage will be done to the tree.

In Brazil it is said that all trees decrease in production of latex in time, but as many paths have been worked for upwards of 40 years, it is not anticipated that, provided judicious tapping is carried on, plantations will become readily exhausted.

YIELDS.

Very little evidence was given as to yields. The average yield of the plantations that have recently come into bearing in Malaya was 1 lb. 12 oz. per tapped tree. These are all young trees, and the average will therefore soon increase. The yield from the forests of Brazil is said to be from $4\frac{1}{2}$-$6\frac{1}{2}$ lb. a day from 100 trees equal to about $4\frac{1}{2}$-$6\frac{1}{2}$ lb. per tree in the year as tapping is carried out for 100 days, while in the Acre Territory the yield is put down at nearly 9 lb. per tree per year.

This book is a most valuable asset to the rubber world and should inspire the utmost confidence in the growing rubber industry. Fresh plantations should be established where soil and climate

are suitable, and what better conditions can be found than in many parts of this colony? The advice of one of the delegates to the conference should be carefully considered. "Its (the rubber manufacturing industry) wants will likewise be constantly on the increase" and the laying out of the plantations should be "approached with zeal and alacrity all the more because it is sure to pay."

F. A. STOCKDALE.

Concerning Poultry.

The largest eggs are produced by steady layers.

A cross hen—that is, one that will peck at you if you reach toward her while on the nest—generally makes the best sitter.

—Natal Agricultural Journal.

The Farmer and Experiments.

"Perhaps one of the things that the average farmer hates most is an experiment. The very mention of it to him seems to convey some idea of inexperience; and for that reason, if for no other, he leaves experimenting alone. And yet how often he could be helping himself! For however good his crops may be looking, there are few which could not be improved a bit, and he is a happy man who possesses all good crops."

—Natal Agricultural Journal.

Dressing for Harness.

The United States Government is responsible (says the Natal Agricultural Journal) for the following recipé for a good harness dressing:—

One gallon neatsfoot oil
Two pounds of barberry tallow
Two pounds beeswax
Two pounds beef tallow

Put the above in a pan over a moderate fire. When thoroughly dissolved, add two quarts of castor oil, then while on the fire stir in one ounce of lamp black. Mix well and strain through a fine cloth to remove sediment; let cool; and you have as fine a dressing for harness or leather of any kind as can be had.

Robusta Coffee.

This coffee, which came originally from the Congo, is now being generally grown in many of the rubber estates in Java, where it is thriving better than most of the other varieties. In 1901 seeds of this coffee were distributed to the West Indies by the Royal Botanic Gardens, Kew, and it was tried in Jamaica, Dominica and Trinidad, and the following extract from a memorandum from Kew was published in the Trinidad *Bulletin of Miscellaneous Information* for October, 1901.

'This is a new coffee from the Congo. It is said to be a free-grower and to fruit freely. The bean is smaller than those of *C. liberica* and they are otherwise distinct. When I was at Gembloux with Professor Laurent a few weeks ago, he prepared coffee from beans of *C. robusta* which differed in flavour and aroma from any coffee I had ever tasted. The general verdict was that this coffee was likely to become of considerable commercial value.'

The plants that were raised in Trinidad did quite satisfactorily and a large number of seedlings were subsequently raised and distributed throughout that colony.

There are now eleven trees in the Botanic Gardens of this colony which were obtained in 1901 and there are several trees at Onderneeming Experimental Farm. They have been fruiting for some time and never seem to be without fruit. Enquiries that have been made from coffee growers in this colony who have this variety under cultivation have elicited the information that this coffee is a heavy bearer, and flourishes well in those parts of the colony where it has been tried. The fruit is produced in clusters on the branches and they eventually assume a reddish colour. These clusters contain from 50 to 100 berries that ripen irregularly. Very little pruning is necessary in this variety and picking is comparatively easy. The cleaned berry is about the size of the Creole variety (*C. arabica*) and the husk is very small. The flavour of the coffee is good.

Seeds for planting purposes have been presented by Mr. J. Junor to the Botanic Gardens; and a large number are being obtained from the plants growing in the Nursery. It is suggested that a more general trial should be given to this hardy variety of coffee in the va-

rious districts of the colony and 3,000 plants will be ready in about another month for sale at the Botanic Gardens. The price charged for these coffee plants is 2 cents each, 20 cents per dozen, or $1.50 per hundred, and requests are invited in advance, as over 500 have been ordered already.

—F.A.S.

The Value of Agricultural Shows.

"Here and there we meet with people who hold the opinion that the Agricultural-Horticultural Shows, held so successfully in the Peninsula have done little good in proportion to the work and money expended on them. For such thinkers the following extract from the "Philippine Agricultural Review" is here inserted as giving the opinions of representatives of the nation which has taken to lead in agricultural work above every other. Speaking of the Kuala Kangsar Show he says: 'The account of these fairs and exhibitions in the Federated Malay States. . . . show how far in advance of us these countries are in agricultural development and progress. Such exhibitions from the various parts of a province, state or island stimulate local pride in their agricultural progress and these in turn create a desire for better knowledge of agriculture as well as better business, and better means of communication which perhaps are the greatest needs for elevating the standard of living in the country in these islands and for encouraging the organization of the people of the country into guilds, unions, or granges for promoting the different lines of agricultural work in which they are interested. It is hoped that the bill recently introduced into the assembly providing for the holding of provincial, industrial, and agricultural exhibitions in these islands (Philippines), or a bill that will meet with the present needs of the country, will become a law and that it will meet with a hearty response and its provisions be immediately taken advantage of by the people of the provinces.'

Thus it will be seen that the shrewd American has a high enough opinion of the value of these exhibitions to push forward a bill for following our example."

—Agricultural Bull. S. and F. M.S., Vol. VIII, No. 10.

Hints, Scientific and Practical.

Under this heading we propose to give, in each issue of this Journal, a number of quotations, from recognized authorities, bearing upon Agriculture on both its sides —the purely scientific as well as the severely practical. In this way we hope to assist those of our readers to whom the procuring of a standard book or works of reference is a matter of time or difficulty.

Drainage. Some of the richest soils are low and flat and in their natural condition crops are injured by too much water. A water-logged soil can never be productive. In such cases improvement by drainage becomes a first necessity. Drains are of two kinds, *open* ditches (or surface drains) and under drains. The amount of ditching required to properly drain a piece of wet land will depend on many things. If the land is low and is flooded by water running down from above, a single ditch dug along the upper side to drain the surface water may be all that is necessary. If, however, the land is inclined to be boggy from water that rises up from below through the subsoil, deep ditches at comparatively frequent intervals will be required. Ditches should always be carefully laid out with a level so as to give them a gradual but uniform fall in order that they may carry off the water promptly.......... Ditching by hand with spade and shovel is laborious and expensive. Where the nature of the soil will permit, shallow ditches can be quickly and cheaply made with the plow (plough) followed by a V-shaped scraper made from one long and one short plank. The long plank acts as a rudder and holds the scraper straight in the furrow, while the short arm pushes the dirt out on to the bank. By giving two or three plowings and scrapings a fairly deep ditch may be dug."

—" Southern Agriculture " by F. S. Earle.

"Puddled." The first fact which we need to understand when we wish to learn how a root advances through the soil, is that the soil grains in the upper four to six feet are never everywhere in close contact with one another. There are great numbers of empty spaces all through the surface layers of earth and we get a very forcible illustration of this fact in setting fence posts. Here we dig a moderate sized post hole, 2 or $2\frac{1}{2}$ feet deep, place a six inch post in the hole, and then scrape and ram into the same hole all of the dirt which was removed from it, and if the job is well done we have

a scant supply to fill it. It is the existence of these unoccupied cavities in the soil which enables roots to make their way through it by wedging it aside. In a thoroughly puddled soil it is impossible for roots to develop, not simply for lack of air, but because there is no room into which it is possible to set the soil aside to make place for the root. When a fine grained soil is thoroughly puddled, all of the small clusters of grains which in a soil of good tilth hold together, are completely broken down, and the smallest particles are packed in between the larger ones until its cavities are so completely obliterated that even water will not penetrate it; and when this is true there is not even room for the root-hairs to make their way between the angles formed by the soil grains, for the finest silt and clay particles have been forced into these to fill them up.

—"Irrigation and Drainage" by F. H. King.

Leguminosae and Atmospheric Nitrogen. The clearing up of the whole subject came with the publication, in 1886, of the researches of Hellriegel and Wilfarth. These investigators found that when plants were grown on sand and fed with nutrient solutions, the Gramineae, the Cruciferae, the Chenopodiaceae, the Polygoneae, grew almost proportionately to the amount of combined nitrogen supplied; and, if this were absent, nitrogen starvation set in as soon as the nitrogen of the seed was exhausted. With the Leguminosae, however, a plant was observed sometimes to recover from the stage of nitrogen starvation, and begin a luxurious growth which lasted until maturity, though no combined nitrogen was supplied. In such cases the root of the plant was always found to be set with the little nodules characteristic of the roots of leguminous plants when growing under natural conditions. Further experiments were made in which the plants were grown in sterile sand, but as soon as the stage of nitrogen hunger was reached, a small portion of a watery extract of ordinary cultivated soil was added; whereupon the plants receiving the extract recovered from their nitrogen starvation and grew to maturity, assimilating considerable quantities of nitrogen. The renewed growth and the assimilation of nitrogen were always found to be attendant upon the production of nodules on the roots. The nodules were found to be full of bacteria, to which the name of *B. radicicola* has been given. They could only be produced by previous infection either by an extract of the crushed nodules, or from a cultivated soil; in some cases (lupins, serradella) only by soil which had previously carried the same crop.

—"The Soil" by A. D. Hall, M.A., F.R.S.

The Germinating Seed. There is a very great deal of difference in the time in which different seeds germinate. Some seeds will do so in a few hours from the time that they are planted; and those quickly germinating seeds quickly lose their vitality. The seeds of the sugar cane are of this class....The papaw will be familiar to you as another plant of that sort. I dare say you have noticed that the seeds are actually germinating and commencing to grow, in many cases, before the fruit has decayed; and if you separate these seeds you will find that they retain their vitality for a very short time, probably only for a few weeks...... That class of seeds that germinate either with absolute rapidity, or with comparative rapidity, are nearly all starch-containing seeds. Those that contain sugars are also generally very quickly germinating ones. This is easy to understand. Take the case of seeds with sugars. As the seeds get the water and the warmth necessary to start off, there is nothing to keep them back, because they have in themselves, in an immediately available form, the material they want to feed upon and from which to build up their new structures. It is soluble and ready to enter into the circulation of the young plant. In the case of seeds containing starch, the starch will rapidly become hydrated, and will be converted into these sugars and start off: but you must give the starch a little time; so that the seeds which are starchy will naturally take a little longer time to germinate than those which contain sugar at the first ......We have the oil-containing seeds. These take a long time to germinate. It may be some weeks before the young plants spring up. The chemical changes demanded in these seeds ere germination can take place is very great and must take time. Under the influence of warmth and moisture and oxygen, and aided by some ferments that are present in these *oily* seeds, the oil tends to become converted into *starch* and into sugar, and is then used up by the plant. Then you have again a certain class of seeds that have thick, horny covers. Such seeds will frequently remain in the soil for a very long time until just the favourable conditions arise for their germination.

—"Lectures to Teachers" by Prof. J. B. Harrison.

The Carbohydrates. With respect to the constituents of plants, there are. three substances especially characteristic, viz.—(1) *cellulose*, the substance of which the fibre of plants mainly consists, and which constitutes the membrane of the cells ; (2) *starch*, a granular substance produced by all green plants and deposited produced by all green plants and deposited in large quantities in the root, stem or seeds of certain plants ; and (3) *sugar*, a soluble

substance existing in the sap. Dry specimens of these in the water oven and then heat in test tubes. Note that they decompose, charcoal and water being produced, showing that carbon, hydrogen and oxygen are constituents. Prepare a strong warm solution of cane sugar. Place it in a large beaker standing upon a plate, and pour in concentrated sulphuric acid. Note that charcoal is set free, the combined water being withdrawn by the acid. Analysis shows that each substance consists of hydrogen and oxygen, in the proportion in which they form water, combined with carbon. They are therefore termed *Carbohydrates*.

—"Chemistry for Agricultural Students" by T. S. Dymond.

Composition of Fresh Avocado Fruit.

According to the analytical data presented by M. E. A. Patrault in the "Bulletin Assoc-Chim. Sucr. et Distill," the edible portion of the avocado has the following percentage composition.

Water, 82.1 per cent.

Protein, 1.2 per cent.

Fat, 8.7 per cent.

Sugar, 2.9 per cent.

Cellulose and undetermined material, 4.6 per cent.

Ash 0.5 per cent.

Starch and tannin were not pre ent. The fat, it is stated, is a green aromatic oil with an odour recalling that of laurel oil, which solidifies at 15° C. The sugar present was not completely identified. It reduced Schling's solution, and hence is not the same as that which has been identified in the avocado seed.*

*This Sugar in the seed is Perseite (= "Laurite" of the late Mr. E. H. Francis sometime Government Analyst, B. Guiana) which was first described by Avequin and Melseus (An. Ch. 72/109) and subsequently investigated by Muntz and Marcano (C.R. 09/38). It was synthetically formed by E. Fischer and Passmore, by the reduction of mannoheptose by soduim amalgam. Mr. Francis did much very exact work on it and showed that it is present in all parts of the tree, for example in the bark, the fruit and seed. Pure samples were later prepared by Prof. J. B. Harrison and Mr. J. Williams in the Government Laboratory. Mr. Francis' name "Laurite' was a bad one, as it tended to promote confusion with "lauric acid" and "laurin," earlier described products from *Laurus nobilis* (the bay tree).

[ED.—*J. B. A.*

Visits to Country Districts.

The Director visited Plantation Hampton Court for the purpose of inspecting the cane cultivation on that estate, and of advising in respect to prospective rubber cultivation. It is thought that rubber might be given a trial on the back lands of the estate if that is possible. He also visited and inspected Onderneeming Industrial School. Improvements are to be made in the drainage near the institution and rubber is to be planted amongst the old coffee cultivation, which is showing signs of falling off. The cacao continues to flourish although no definite conclusions can yet be formed from the manurial experiments. The live stock is in satisfactory condition, with the exception of the Shorthorn bull, which is suffering from fever and is receiving careful attention at the hands of the Veterinary Surgeon and the Agricultural Superintendent, who is acting as Superintendent of Onderneeming during the absence of Mr. S. H. Bayley on leave.

AT PLN. NON PAREIL.

The Assistant Director visited Plantation Non Pareil in connexion with the large moth-borer of sugar-cane (*Castnia licus*). He visited the different fields aback in company with the manager. A fair number of larvæ were found in the stumps of the canes that had lately been cut, and many dead canes were to be observed in the 'high' canes. No adults appeared to be on the wing.

BERBICE.

The Assistant Director visited New Amsterdam, where he inspected the Public Gardens, Berbice, and the Prison farm. The Gardens were in a satisfactory condition and the Prison farm was a credit to those in charge. Some of the plantains were excellent, and careful attention was being given to rotation, tillage and drainage. The lime and rubber cultivation at Pln. Providence under the care of Mr. Edgar Beckett was visited. The young limes have made very satisfactory progress, and experiments are being commenced with *Hevea* and *Sapium*. Gumming and scale insects have been present among the trees, but they have received careful attention and it was difficult at the time of the visit to find any scales, as spraying with rosin wash had been continuously carried on. The limes had grown very well during the time that they had been planted and Mr. Beckett pointed out some interesting examples of the difference in growth in many of the lime trees raised from seed procured

in different parts of the colony. A trip was also made up the Corentyne coast by motor-bus to Pln. Skeldon, and some interesting points in connexion with the agricultural pursuits of that district noted.

ONDERNEEMING.

The Superintendent of the Onderneemimg School having gone on short leave the Agricultural Superintendent has assumed charge of Onderneeming, and is visiting some of the cultivation in Essequebo.

BONASIKA.

The Senior Agricultural Instructor has visited Bonasika to continue the rubber-tapping experiments being conducted there with *Sapium Jenmani*, and the Assistant Director also visited the rubber station during the tapping experiments in order to investigate some points brought up by the Forest Officer, when the last tapping took place. The Senior Agricultural Instructor has also visited the Pomeroon and has made definite arrangements for pushing on the work at the Experiment Station being established in that district.

The Head Gardener visited New Amsterdam to inspect the Public Gardens and to procure specimens for the recent Teachers' Certificate Examination.

WAKENAAM.

The Assistant Gardener has visited Wakenaam to enquire into a disease affecting plantains in a part of that island, and visits have been made by junior officers to the Canal districts, the West Bank, Demerara River, the East Coast, and Berbice.

F.A.S.

Para Rubber in Acid Soils.

" Many complaints of diseased (rubber) plants were found to be due to excessive acidity in the soil. This source of trouble is fairly common in the humus-rich peaty soils of the Coast districts . , . . Good drainage and the application of lime usually neutralizes the soil sufficiently . . . I recommend the application of lime to such soils."

—W. J. Gallagher in Agricultural Bull., F.M.S.

Board of Agriculture.

The quarterly meeting of the Board of Agriculture was held at the new Offices of the Board, Charlestown, on Thursday, January 14, His Excellency Sir F. M. Hodgson, K.C.M.G., presiding. Those present were Professor J. B. Harrison (Director of Science and Agriculture), Mr. F. A. Stockdale (Assistant Director), the Hons. B. Howell Jones and C. P. Gaskin, Messrs. J. Downer, J. Wood Davis, J. Gillespie, J. Junor, J. Monkhouse, W. M. Payne, and J. J. Quelch, with Mr. O. Weber (Secretary).

A NEW HOME AND AN OLD FRIEND.

His Excellency, in opening the meeting, referred to the new Offices of the Board and remarked that he was sure the members would be glad to find themselves at last in their own quarters. It was a building he had long wanted to take over for the Department of Science and Agriculture and for the use of the Board. He hoped to introduce into the Court of Policy an Ordinance to establish the Board of Agriculture on a firmer basis; to give it greater powers than it had at the present time; in fact, to recognise it as a Board of Agriculture doing a great deal of good work. The powers of the Board would be expressed in the Ordinance, and they would know exactly what they had to do and what they were able to do. The Bill would probably be introduced at the next meeting of the Court of Policy. Continuing, His Excellency, on behalf of the Board, expressed pleasure at seeing Mr. Quelch in the colony once more. He had come out, as they knew, to investigate the ravages of the cane-borer on certain estates. These ravages had been very severe and Mr. Quelch would endeavour to find out what steps should be taken to stop them. With regard to Sir Daniel Morris, who had done a great deal for agriculture in the West Indies, it had been thought right to appoint him an honorary member of the Board. Sir Daniel Morris had accepted the appointment.

ON THE TABLE.

The Report of the Department of Science and Agriculture and of the Board of Agriculture for 1908-9, and the Journals of the Board for July and October, 1909, were laid on the table, Professor Harrison remarking that in the October number there was an article by Mr. Stockdale dealing very fully with the question of banana cultivation.

COCO-NUT CATERPILLAR PEST.

A report by Mr. Stockdale on the attacks by *Brassolis sophoræ* on coconut trees was submitted.

Professor Harrison said the report was a continuation of one made by Mr. Bartlett. He thought Mr. Stockdale might mention his recommendations and that Mr. Quelch should be asked to make some remarks on the subject.

Mr. Stockdale stated that the district which he visited was Mahaicony, where the pest was very bad. The caterpillar made a 'nest' of the leaves, binding them together with a strong thread. It slept in the nest during the day and fed during the night. The simplest remedy was to cut out and destroy every 'nest,' by which means from 200 to 300 caterpillars were destroyed at a time, and their ravages considerably checked. The 'nests' could easily be seen. A good many people had adopted this remedy, and from reports received, it had proved quite successful.

Mr. Quelch said the trouble was that in many of these cases the caterpillars attacked more than one variety of plant. The only remedy therefore was persistence; to keep looking for the pest, which might travel from one cultivation to another; and to continue Mr. Stockdale's remedy year by year.

Mr. Howell Jones remarked that he had noticed the nests on courida trees. At Chapman's Grove, where so much damage was done a few years ago, all the courida trees had been removed, and the caterpillars had nowhere to build their nests but on the coco-nut trees. The caterpillars travelled a considerable distance at night.

Mr. Quelch said that the caterpillars were also found on lilies.

COMPULSION.

His Excellency was afraid that people did not always do what they were told. They were indifferent. They might obey instructions once or twice ; but beyond that they did not go. They would have to consider whether they could ensure action on the part of the people. They might send somebody around to see whether the people were doing as they should do, and if not, to take powers to compel them to do it. That seemed to him a practical way of dealing with the matter. It was all very well to find out what was the remedy they should apply, but they must go a step further and see that it was done, for the good of the colony.

Mr. Gaskin agreed. Thousands and thousands of trees had been destroyed. One man took an interest in his property and look-

ed after it, while another left the pest to spread. They ought to have powers to see that the people were carrying out their instructions.

His Excellency urged that the first step was to get the Board of Agriculture to find out where the pest chiefly existed.

Mr. Stockdale said they already had reports from a good many places.

His Excellency said they should have a complete list and then a report might be made to him. He was glad to see that the exports of coconuts had increased very considerably in the past year.

Mr. Howell Jones thought the caterpillars were not so serious as the fungi from dead trees which were allowed to remain on the farms.

His Excellency suggested that their investigations might include both.

The Director said they would deal with the whole subject of insect and fungus pests, and lay down what steps were necessary to enforce the remedies proposed.

CASTNIA LICUS.

Professor Harrison, dealing with *Castnia licus,* or the moth borer of sugar-cane at Pln. Non Pareil, said it was no new complaint. They had to deal with it in 1904, and as for a long time they had no reports of the caterpillar doing harm, they naturally thought that the trouble had subsided. But last year they had learned it had become worse than ever. A circular was first issued to get information as to how it was distributed, and then a second circular making suggestions to combat the pest. Among the suggestions he made was one that Mr. Quelch should come out to inquire fully into the life history of the moth and advise, if possible, measures for its extermination. Mr. Quelch might perhaps give them a short account of it from his present knowledge and express an opinion as to the steps that had already been taken.

Mr. Quelch replied that it was rather early for him to say anything; but the steps suggested by the Board seemed to him to be such as should have been made. The pest seemed very widespread. He had seen many borers about the fields dead.

His Excellency asked to what he attributed this.

Mr. Quelch said it was due to the unusually heavy season and the cold evenings. The period of egg-laying seemed to be a prolonged

one. It seemed a wide question to deal with, and was very serious. It was only by persistence they would destroy the pest, and now that the borers seemed to have some difficulty in increasing their numbers it was just the time when everyone should do their utmost.

WISE ESSEQUEBO.

Reporting on the Suddie Model Garden, the Director mentioned that the sales from the stall for economic plants established at Suddie had not been very numerous because the season had been extremely dry and the people of Essequebo were too wise to plant in droughts. The Model Garden there was in excellent order, and was being used by people in the neighbourhood as well as by the pupils of the school.

The instructions on the cultivation of bananas and plantains drawn up by Mr. Stockdale and published in the *Official Gazette* were submitted.

Professor Harrison said a large number had been circulated in the colony.

THE UNEMPLOYED.

Referring to the appointment of a Banana Commission, His Excellency said they had to remember the question of labour. It was all right if they were going to deal with small cultivators, but when it came to large cultivators it must be remembered that the colony had only 320,000 inhabitants, all of whom were almost fully employed. There was always an outcry for employment, but it was generally recognized that most of the unemployed were really wasters. With a population of only 320,000 they could not undertake wonders. He hoped the Commission would get statistics to see exactly how matters stood, and whatever they recommended would receive full consideration from the Government.

THE ESTIMATES.

The estimates for 1910-11 were submitted by the Director, who explained that they had been very carefully drafted by the Financial Committee of the Board. They made provision for an agricultural instructor to be specially attached to Berbice.

His Excellency intimated that the Veterinary Department was to be transferred from the Medical Department to that of Science and Agriculture. The duties of the Veterinary Surgeon blended more with that Department than with the medical. It was merely a transfer.

The Director, continuing, said that he had to ask more for the travelling expenses of the additional officers. They had

asked His Excellency to make provision for the upkeep of the geological collections. These were rather extensive now and it would be a great pity to let them go, and perhaps spend thousands of dollars in future years in replacing them. A small increase was required for the nursery economic section. That would be covered by increased sales, however. The increase in this department was most satisfactory; for it showed that the people were taking full advantage of it. Under the heading of agriculture a small increase was required for sugar-cane experiments. Farmers' competitions would be carried on in much the same way as last year. They would have to draw in a little with regard to them, however, because they wanted to get in a certain amount to encourage the people on the West Bank to grow cacao and coffee. Rice remained the same. They wanted $750 which would be required to carry on the new station on the Pomeroon. The estimates, which had been approved by His Excellency, were somewhat larger than last year, but he was afraid that would always be the case with the Board of Agriculture, so long as that Board looked after the interests of the colony.

The Governor said he should have liked the estimates to be more extensive, because he thought the Board of Agriculture was doing extremely good work in the colony. But times were not so good now as they had been, and they had got to be very careful about adding items to the estimates.

BUXTON AND WEST BANK EXHIBITIONS.

Professor Harrison reported that both the Buxton and West Bank exhibitions were satisfactory. The West Bank Show was exceptionally satisfactory and seemed to show an improvement every year.

APPLICATION FROM THE WEST BANK.

An application was received from the West Bank Farmers' Association for a grant-in-aid of an exhibition, but this was held over till the estimates had been passed.

An application was received from the Buxton Farming Association for assistance in their efforts to encourage the people to grow fruit.

Professor Harrison said a suggestion had been made by some members of the Subsidiary Products Committee to give plants free of cost to some of the villages and districts; but the question of free plants had been thrashed out some years ago, when it was decided not to give the plants free, but to make a small charge for them, to make sure of the people taking proper care of the plants,

His Excellency and he were still of the opinion that a small charge should be made.

The Governor said that the general rule was to make a small charge, though there might be special cases where for some special reason they might distribute the plants free. There was no special circumstance in this case.

Mr. Wood Davis agreed and thought the Board's assistance ought to take the form of giving the plants at the lowest possible price and giving them advice. Originally he advocated the free gift of plants, but now he saw he had made a mistake. People would undoubtedly take more care of the plants if they paid even a little for them. Then if they gave Buxton this privilege, every other district would be wanting it, too.

The Governor explained that arrangements had been made for giving expert advice. He suggested that forms containing instructions as to what to do should be given away to purchasers of plants.

SALES AT THE STALLS.

The Director reported that at the New Amsterdam stall belonging to the Board, 2,464 plants had been sold for $75.24; at the Georgetown stall 4,008 plants for $141.45, making a total of 6,400 plants sold that would not have been sold at all if there had been no stalls. The figures for last year were far more favourable than those for the preceding one.

The Sugar-Cane Committee of the Board had decided that new canes grown at the Botanic Garden should be distributed in May and June. He had had no complaints and assumed that the results were satisfactory.

SPECIMENS OF RUBBER.

Reporting upon the stations at Bonasika and Pomeroon, Professor Harrison said that they had erected a house for the visiting officers at the former and had got the station in working order. He had a series of photographs taken by Mr. Anderson of the *Sapium Jenmani* growing at the station. Mr. Anderson also submitted specimens of some rubber prepared at Bonasika, and some that had come from first and second tappings.

Mr. Stockdale said that a number of seedlings of *Sapium Jenmani* had been obtained from Bonasika. They had been using the station for that. During the year they had taken about 11,000 seedlings, the greater portion of which had been sold. A few had been lost in transit. They had about 3,000 on hand at the Botanic Gardens, a fair number of which had been booked.

His Excellency said that there had been some delay in establishing the station on the Pomeroon River. The Government had not got a piece of land such as they wanted and they had to negotiate for the lease of such a place. They had now obtained it and were proceeding to put up buildings and to clear the ground for planting.

Professor Harrison explained that most of the ground had already been partially cleared; and the house of the Instructor was nearly finished. The Instructor was leaving for Pomeroon that afternoon.

They had some samples of rubber, *Hevea brasiliensis*, grown at Onderneeming from trees brought from Trinidad in 1903. Also some samples of rubber from *Futnumia elastica* were exhibited. He was afraid there was no chance of *Funtumia* growing satisfactorily in this colony.

Mr. Stockdale said that they got 30,000 seeds of *Hevea brasiliensis* from the Straits Settlements, and had another 30,000 on order. The germination this year was 70 per cent. and 21,000 of the first shipment had been basketed in the Botanic Gardens ; 12,000 had been ordered, leaving a balance ready for distribution the first week in February.

Professor Harrison said that they had been in communication with the Imperial Institute with regard to the utilisation of the cedar wood that grew here; and they had sent some specimens to experts. He had got a letter from Professor Wyndham Dunstan.

Specimens of cedar wood, white siruaballi, and crabwood had been sent which Professor Dunstan said had been carefully examined to determine their suitability for the manufacture of cigar boxes. He added: " The technical expert to whom specimens of the cedar wood were submitted, reported that in his opinion the cedar wood and crabwood are proved to be suitable for making cigar boxes. He stated tha there are several varieties known as siruaballi, all of which are easily worked and may on that account be employed for the purpose above mentioned although they would probably not be so satisfactory as the cedar wood and crabwood.

" Specimens of the timber were then submitted to an important firm of cigar manufacturers at whose factory they were tested. The firm reported that of the three timbers only the cedar is likely to be suitable for the manufacture of cigar boxes. The crabwood is stated to be too heavy, of unplea ant odour, and too dark in colour,

The prejudice in favour of the present type of cigar boxes is said to be very strong, and it would be very difficult to introduce a substitute of its appearance. The wood at present used by the firm is red cedar from Cuba, which is now becoming scarce and expensive. Although they make all their cigar boxes in London the firm do not import logs as they find it more convenient to buy all the wood they obtain from their agent in Bremen.

" The agent in question who also examined the woods stated that he was prepared to take a trial lot of 25 to 50 logs of the cedar wood, preferably square hewn logs from 12 inches square towards 18 to 24 inches square, or more preferred. The logs are shipped to London or Liverpool. He is willing to pay any reasonable price that may be asked and he can order large quantities if test and price are satisfactory."

Professor Harrison said that the Colonial Civil Engineer took a very great interest in the development of our forest industries and was endeavouring to get cedar logs together for this purpose.

Mr. Howell Jones referred to the excessive freights charged for the export of timber from this colony. They had been raised by 50 per cent.

Mr. Payne said that some splendid samples of timber had been received from Messrs. Farnum & Smyth, and suggested that inquiries should be made of them.

THE NEXT AGRICULTURAL CONFERENCE.

His Excellency mentioned that it was the desire of the Board that the next Agricultural Conference should be held in this colony. It would have to be in 1911. Dr. Watts, whom he saw in England, was very much afraid that the Imperial Department of Agriculture would be unable to comply with their wishes. A final decision had not been arrived at, and (after some discussion) His Excellency said he would communicate further with Dr. Watts on the matter.

RICE.

The returns of rice cultivated at the Botanic Gardens were submitted.

Professor Harrison said that the rice experiments had been carried on over a period of six years, during which time a very large number of varieties of rice had been examined. From all the different kinds they had been able to pick only three which were equal to or better than the creole rice. Specimnes

of these were on the table. By its general characteristics No. 75 was the finest rice of the lot. The average yield of it was 37 bags per acre. One or two others had given a higher yield but were not so good in quality. The rice was being distributed under the new scheme which they adopted last year, but that would not prevent them giving quantities for agricultural purposes to those who would prove that they would use it properly. There was no intention of going back to the old system of giving away the rice to anyone who came and asked for it. When the rice was given out they wanted people not to use up the whole crop but to sow larger areas year after year. It was very important that rice should be very carefully selected before being sown. They had found ten or twelve different varieties mixed together in one sample. They had an instance from Honduras, whence a sample of rice was sent to them with the information that it was much better than anything British Guiana could produce. Six kinds of rice were found in that one sample. The yield varied from 36 bags to 9 bags per acre. It was a most important point for all cultivators of rice to recognise that they must select most carefully their seed paddy.

His Excellency asked if it was found that the recipients of the rice mixed it with other rice.

Professor Harrison said he did not know what most of the recipients did with it.

His Excellency : Shouldn't we be careful to see that it is sown entirely by itself instead of being mixed with other rices.

Professor Harrison said the Department proposed to issue very shortly a circular dealing with rice cultivation as a whole, and the importance of this point would be dealt with. The Department had had to learn how to grow the rice because none was grown in the Gardens until 1903.

SHORTHORN BULL.

Professor Harrison said that a new Shorthorn bull arrived in the middle of November. It was a very nice animal, but almost directly after it arrived it contracted some peculiar form of fever and from this it had since been suffering steadily. The temperature was between 104 deg. and 105 deg. It was examined by the Veterinary Surgeon and expert members of the Board, and the only opinion that could be arrived at was that no one could understand what was wrong. After six or seven weeks the temperature went

down to normal but it had now risen again. He regretted to say that the other Shorthorn bull at Onderneeming was suffering from a somewhat similar fever which started about the middle of December. This bull had been keeping a temperature from 104 deg. upwards and one day it actually reached 108 deg. The fever was utterly unknown. There was no appearance whatever of Texas fever. The Veterinary Surgeon had the assistance of the bacteriologist, but they had got no further.

His Excellency said that this raised the whole question of the desirability of continuing to import Shorthorn bulls into the colony.

Mr. W. M. Payne said that the had raised this question before on the advice of a very old colonist. It was suggested to him that instead of Shorthorns they should import Polled Angus. Shorthorn bulls had been a very expensive investment.

His Excellency: Very. We have the two Shorthorns and we are just keeping them alive.

Mr. Payne: The best bull is at 103 deg. to-day.

His Excellency said that a paper was in circulation regarding the desirability of continuing the importation of Shorthorn bulls.

THE MOST FORTUNATE COLONY.

Mr. Howell Jones said that they had been the most fortunate of all the colonies in importing animals, having had the greatest success of any of the places. A great deal of progeny had been reared from time to time in the colony. The reason why he always stuck to Shorthorns was that he originally proposed it on the advice of one of the vice-Presidents of the Royal Agricultural Society of Scotland, who told him the Shorthorn was the best animal in the world. In the Argentine they were surpassing Britain in the value of their Shorthorn bulls. He himself had imported Aberdeen-Angus cattle and had great trouble with them.

LIVE STOCK SALE.

The date of the annual sale of Government live stock was fixed for 16th February, on the D'Urban Race Course.

Mr. Payne suggested that the catalogue should be sent round the islands. He had a lot of enquiries about it when he was in Barbados.

REPORT ON ANIMALS.

Professor Harrison said that the report on the Board's animals was as usual satisfactory, with the exception of the two bulls referred to, of one ram which was very ill and had since died—and of the stallion *Orestes* which was suffering from eczema.

Mr. Payne said he considered that the horses were not in good condition. They had done their duty. New blood should be imported.

Mr. Howell Jones agreed. It was the original intention of the Board that no new animal should be kept in the colony longer than three years. There should certainly be no interbreeding of animals. That was the very worst thing that could happen.

His Excellency said that this matter had been under the consideration of the Director of Science and Agriculture and himself, and a paper would be prepared for the consideration of the Combined Court. It was the view of the Board that the stallions had served their purpose.

TRYPAN BLUE.

Professor Harrison, referring to the use of trypan blue in combating Texas fever, said that Mr. Howell Jones drew the attention of the Board to it and they had since been in correspondence with Professor Nuttall, of Cambridge, regarding it. Some of it had been sent out and tried on the bull at Onderneeming. The animal did not seem to like the injection which apparently was not successful. Further supplies were to be got. It would be most important if they found a cure for this fever.

Mr. Howell Jones stated that the South African farmers were using it to a very large extent and with very great success. There was hardly a case where they failed to save an animal from Texas fever.

MR. GASKIN'S MOTION.

Mr. Gaskin moved a motion to the effect that a free analysis be made of certain food products, samples of which had been prepared by a namesake farmer and were now produced. If the purpose was to get an analyst's certificate for the purpose of trading on it, it should be paid for, but he understood the gentleman wanted the samples analysed for the benefit of the general community. The results might be published in the *Official Gazette*.

Mr. Payne seconded.

His Excellency said this matter had been brought before the notice of the Executive Government, which thought it inadvisable

to accede to the application because the petitioner might use it as an advertisement. If that were so it was only right that a fee for the analysis should be paid.

Professor Harrison pointed out that none of the samples were of new products. Publishing an analysis in the *Official Gazette* would be the finest advertisement possible.

His Excell ncy: It would be regarded as giving a Government guarantee that the stuff was as shewn by the analysis.

The motion was withdrawn.

INSECT PESTS.

His Excellency intimated that a Conference on Entomology was to be held at Brussels. It was out of the question to send a delegate but the publications would be useful and should be got.

This was agreed to, and the Board was adjourned *sin die.*

The Duty of the Planter.

"The Government has provided experts, but, after all, these gentlemen are limited in their observations because they are not able to observe details of soils, situations, rainfalls, and many other conditions which affect agricultural products. If all this work is to be left to the Government's scientific advisers, I am afraid that the future of the (rubber) industry is really in grave peril, because the essence of the industry is that it starts with a most violent interference with the ordinary course of nature. It is the essence of the industry that those engaged in it should be constantly watchful of the health of the plants from which they expect to get their returns. The opportunities which the Government observers have are limited in every direction, and unless those who are in contact with the production throughout the whole country are on the watch and ready to call attention to anything unusual, I am afraid that the little the Government observers can do will not be of very much avail. I think that not only should we expect, but we have the right to expect, that planters should themselves constantly observe what is going on in their plantations."

—Sir John Anderson, G.C.M.G., (Governor of the Straits Settlements) at the Penang Agricultural-Horticultural Show, 1909.

Answers to Correspondents.

V. L.—Rubber requires a good rainfall and an even temperature. It is now becoming generally recognised that more depends upon the temperature and the actual number of wet days than upon the actual amount of rain that falls. Continuous dry winds and a prolonged dry season will retard the growth very considerably and may render the cultivation of rubber unremunerative. Make careful inquiries as to the rainfall and as to the nature of the soil.

S. P. & Co.—The leaves you forward are leaves of *Sapium Jenmani*, the native rubber-yielding tree. Plantations of this tree in the North Western District look very promising, samples of rubber prepared for the Rubber Exhibition have been valued at practically the same price as fine Para, and further tapping experiments are now in hand.

HEVEA.—The distance for planting most generally to be recommended is 20 feet by 20 feet.

RUBBER COY.—Plans showing the chief and greatest difference, between various species of *Hevea* and of *Sapium* are enclosed. The native *Heveas* are not known to yield a rubber of good commercial value.

L. A. R.—Very pleased to hear that the treatment for the diseased coconuts has been successful. In all plant-diseases however, it is necessary that remedies be applied at the first sign of the disease and that a constant watch be kept. Pay very careful attention to your drainage.

T. H., ESSEQUEBO.—Coleopterous larvæ and numbers of dipterous larvæ were present. They will be bred through but the dipterous larvæ are most probably of secondary importance.

INSTRUCTOR N. W.—The specimens you sent were specimens of corn smut. The cobs were attacked by the fungus.

USTILAGO MAYDIS—Advise growers to collect and burn all diseased ears, and to plant no seed corn taken from a field in which the disease was prevalent.

CORENTYNE.—Coushie Ants can be got rid by puddling. Refer to *Journal of the Board of Agriculture* for April, 1908.

MAHAICONY.—The sweet potato weevil is *Cylas formicarius*, common in Texas and some of the Southern United States. It

is also known to occur in Jamaica, but has not yet been found in the Leeward or Windward Islands.

A. C.—The sprayer that has given satisfactory results is the 'Success' knapsack sprayer, but other good makes are the 'Eclair' and the 'Antipest.'

R. S.—The enclosed drawings of *Castnia licus* may enable you to identify this pest. If, however, you have any doubt send some specimens to the Department of Science and Agriculture for examination and report.

WAKENAAM.—This disease of plantains will be investigated. It seems to be the worst on very badly drained low-lying land. A similar disease is being reported from Berbice.

L. K.—Drainage must be very carefully attended to. Diseases will make their appearance if drainage is neglected, and remedies cannot be effective on badly drained cultivation.

The Secret of Success.

To be successful with poultry it is essential to have a love for it without that it is mere drudgery, and drudgery is seldom apt to meet with success.

—Natal Agricultural Journal.

Armies and Sugar.

Captain Kobayashi, of the Japanese Army, has given some interesting particulars of the results obtained by the use of sugar by the Japanese army during the recent war. He says: " We used large amounts of sugar during the Russo-Japanese war; a quantity of almost 20 lbs. for a company of 200 men, *i.e.*, on an average, 50 grams (nearly 2oz.) for each man, per day, had the effect of imparting an extraordinary endurance to the troops." These statements are valuable, for they confirm the well-known fact that sugar is a food of the highest order, and they give us, for the first time, exact figures for the study of the question of the consumption of sugar by armies on campaign.

—The International Sugar Journal, October, 1909.

The Model Gardens.

Record of Attendances.

Below is given a table setting out the number of pupils who attended the Model Gardens of the colony, arranged in quarterly periods from April 1, 1907:—

	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Total Attendances.
1907								
April 1 to June 30	305	337	412	329	12	...	...	1,395
July 1 to Sept. 30	381	298	202	285	256	...	...	1,422
Oct. 1 to Dec. 31	575	293	380	221	288	...	...	1,757
1908.								
Jan. 1 to Mar. 31	597	731	389	299	187	...	...	2,203
April 1 to June 30	1,438	860	183	274	243	...	...	2,998
July 1 to Sept. 30	1,698	976	440	199	212	...	...	3,525
Oct. 1 to Dec. 31	1,714	819	465	115*	411†	160‡	...	3,684
1909.								
Jan. 1 to Mar. 31	1,638	710	338	463	370	302	...	3,821
April 1 to June 30	1,707	677	329	142	288	446	...	3,589
July 1 to Sep. 30¶	2,252	742	433	436	172	378	223‖	4,636
Oct. 1 to Dec. 31	1,876	536	438	236	362	771	439	4,858

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during the instruction given by the Superintendent Teacher. It has not yet been found feasible to keep a record of the many attendances during his absence.

* School in vacation November and December.
† Vacation in December.
‡ Instruction commenced in November.
¶ Schools in vacation during August.
‖ Instruction commenced in July.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the Colony exported during 1909. The corresponding figures for the two previous years are added for convenience of comparison :—

Product.	1907.	1908.	1909.
Sugar, tons ..	99,297	110,657	115,633
Rum, gallons ..	2,107,129	2,190,580	2,154,317
Molasses, casks ..	1,462	1,431	2,539
Cattle-food, tons ..	10,378	7,932	9,504
Cacao, cwts. ..	639	939	574
Citrate of Lime, cwts. ..	3	13	54
Coconuts, thousands ..	553	200	636
Copra, cwts. ..	—	186	467
Coffee, cwts. ..	2	190	1,122
Cotton, lbs. ..	63	12	—
Fruit, brls. and crates ..	5	60	1
Ground Provisions, value	$ 2,739 05	$2,115 06	$ 225 32
Kola nuts, cwts. ..	32	1	38
Rice, tons ..	2,700	3,867	4,729
Rice-meal, tons ..	—	2,498	1,911
Starch, cwts. ..	26	—	—
Cattle, head ..	1,125	1,451	992
Hides, do. ..	4,772	2,979	3,490
Pigs, do. ..	—	984	872
Poultry, value ..	$ 583 60	$ 234 72	$ 224 52
Sheep, head ..	174	41	74
Balata, cwts. ..	8,814	10,040	9,231
Charcoal, bags ..	82,957	76,617	78,410
Firewood, (Wallaba, etc.) tons	6,249	7,051	8,499
Gums, lbs. ..	5,952	1,133	6,916
Lumber, feet ..	90,376	53,267	210,137
Railway Sleepers ..	4,000	4,000	3,350
Rubber, cwts. ..	55	61	57
Shingles, thousands ..	1,878	2,996	2,122
Timber, cubic ft. ..	211,672	214,743	219,516

Selected Contents of Periodicals.

Agri. Horticultural Show, 1909, and Speech of H. E. the Governor
—Agric. Bull. S. & F.M.S. September, 1909.

Canning Vegetables in the Home.

Biliary Fever of the Dog.
—Agric. Journal C. Good Hope, September and October, 1909.

The Valuo of Humus.
—Phillippine Agri. Review, Vol. II, No. 3.

The Construction of Cow-houses.
—Journal Board of Agric. (England) Vol. XVI, No. 7, Oct., '09.

A Ripe Rot of Mangoes.
—Trop. Agriculturist, October, 1909.

Quarantine in the British West Indies.
—The Colonial Office Journal: October, 1909.

Pests and Parasites. The Entomological Work of the Hawaiian

Sugar Planters' Association.
—Hawaiian Planters' Monthly, October, 1909.

Army Worms and Cut Worms on Sugar Cane.
—H.S.P.A. Experiment Station Buletin 7 (Hawaii).

Seme New Mexican Rubbers : by P. Olsson-Seffer, Ph. D.
—The India Rubber Journal, November 15, 1909.

The Extension of Fibre Plants.
—Agric. Journal of India : October, 1909.

Forwarding Diseased Specimens for Examination.

In a former number of the Journal (Vol. i., pp. 53-5) hints were given as to the preparation, packing, and transmission of Specimens to the Government Botanist's office, but it is thought advisable to bring forward again the most essential points, for the guidance of those who have not the former article available.

(1.) A few fragments of a diseased plant are of practically no value for a scientific investigation. Sufficient material should always be sent, so that the primary cause of the trouble may be located.

(2.) Full particulars should be given as to the nature and extent of the damage done, the part of the plant attacked, the nature of the soil, drainage, the prevalence of the disease, when it was first noticed, and whether any similar kind of disease had been previously observed in the neighbourhood.

PACKING.

(3.) Specimens of portions of plants attacked by fungi may be sent green if packed in a well-ventilated box if the time taken for delivery is under 24 hours, but if delivery takes a longer time all leaves or soft fruits should be placed in a bottle or corked tube containing a solution made of 1 part of rum or methylated spirit and 2 parts of water. As many stages of the disease as possible should be sent, with notes as to the nature of each stage.

(4.) Living insects should always be packed with a supply of the plant on which they were found feeding, and the box should have some small holes pierced for purposes of ventilation. These should be carefully packed in such a way as to prevent their becoming crushed in transit.

(5.) Hard-bodied insects such as beetles, grasshoppers, bees, etc., may be killed by immersing in boiling water for about half a minute. They should be allowed to dry, be wrapped loosely in soft paper, each insect in a separate piece, and then packed in a strong box.

(6.) Butterflies and moths should be killed in a poison jar or by squeezing the body below the insertion of the wings. They must be handled carefully to prevent injury. Butterflies should have their wings folded back to back and each specimen separately folded in paper, while moths may be wrapped loosely in tissue paper.

(7.) All soft-bodied insects such as grubs, worms, plant-lice, etc., should be sent in small bottles preserved in diluted rum or other spirit.

FORWARDING

All specimens should be accompanied with detailed particulars of the nature of the disease and should be addressed to :—

THE GOVERNMENT BOTANIST,
Botanic Gardens,
Georgetown.

THE JOURNAL
OF THE
BOARD OF AGRICULTURE
OF
BRITISH GUIANA.

VOL. III. APRIL, 1910. No. 4.

The Mutual Insurance of Live Stock.

By dealing with Agricultural Banks and the St. Vincent Land Settlement Scheme we have endeavoured to bring to our readers' notice some of the benefits of Co-operation in its broadest sense; in this number we would discuss yet another phase of the same prolific theme. Given the social instinct, the practical appreciation of the proverb "Unity is Strength," the mutual forbearance, the give-and-take and trust between man and man which comes of self-respect and that consideration for others which is not compelled by the trickery of the law or the *force majeure* of the police—given Civilization, in short—and it is wonderful in how many ways and directions the principle of Co-operation can advance prosperity. Take the mutual insurance of live stock for instance. It is one of the oldest forms of co-operation in England: a society for the purpose was registered near Brunswick in Lancashire in 1807; a system of insurance for horses has existed in Denmark since 1100*: and with the extension of allotments and small holdings associations of this type seem likely to increase in number. Let us consider for a moment some points in the rules of such a society—points which have been proved of value by practice and would therefore have to be submitted were these societies introduced into British Guiana.

In the first place, then, live stock insurance companies can be established by mutual agreement and are not, in England, required by law to be registered or formally incorporated in any way. It must be remembered that the mere fact of registry affords no guarantee of the solvency of a society. In the case of registered societies the principle of unlimited liability is adopted; a point

*This remarkable statement is given on the authority of Mr. Consul Funch, quoted in "The Journal of the Board of Agriculture" (England), October, 1908, page 523.

which, with the restriction of the operations of the association to a small area, will recall the organization of the Raiffeisen banks. Unlimited liability might be supposed to lead to serious difficulties if the insurance of valuable pedigree stock were undertaken to a greater amount than the funds of the society would justify ; but this difficulty does not arise in practice. The clubs confine their insurances to small amounts and the risks incurred are, therefore, not great. The limited area of operations makes it possible for all the members to know each other, and this is a protection against fraud or intentional neglect by members. The duties of inspection, valuing, and marking are also rendered easier. One objection, however, is that in the event of great mortality, such as would be caused by an epidemic of contagious disease, the society might be unable to afford help when most needed. In England a crucial case does not seem to have arisen—perhaps owing to the great care exercised by the members of the clubs, who evidently realize their mutual reponsibility—while on the Continent re-insurance provides the solution of the problem.

The method of raising fund is commonly by an entrance fee and a fixed annual subscription for each animal, in addition to a charge for inspection and marking on entry. Many clubs provide for a levy on all the members equally in the event of the funds being insufficient in an emergency. In some cases each animal is valued on entry and re-valued annually, a scale of premiums proportionate to the value being adopted. This system removes the objection, particularly in the case of cows and horses, that the owner of a high-priced animal pays no more than the owner of one of less value, though in the event of loss he would receive considerably more from the society's resources. Funds not wanted for immediate use are invested under strict regulations, largely in savings banks. Compensation is frequently paid at the rate of three-fourths of the full value, but in some cases the full value is allowed up to a certain stated limit. It would certainly seem desirable that something less than the full value should be paid. In the event of compulsory slaughter by Government or local authority's order, the compensation payable by the society would be only the difference, if any, between the sum for which the society was liable in case of death and the amount actually paid by the ordering authority. It is therefore to the advantage of the club to insist that its members promptly report to the local police the suspected existence of any scheduled disease. No compensation should be paid to any member who fails to report. Some clubs undertake to pay the fee of a veterinary surgenn called in to attend on sick animals, provided the

necessary authority is first obtained from the committee of the society. It would probably be convenient to arrange with a veterinary surgeon to attend in such cases at a fixed fee.

The accumulation of a substantial reserve fund is undoubtedly desirable as a protection in the event of an epidemic of disease occurring in the neighbourhood but it is very necessary that suitable provision should be made in the rules for the auditing of accounts and inspection of books. Under the English law, the registration of a society ensures the proper keeping of the books, as a balance sheet, called the Annual Return, duly audited and signed by the secretary and treasurer, has to be sent each year to the Registrar. Some such precaution could hardly be omitted here.

Science as a Time Saver.

What it may take the combined wisdom of a whole community of farmers half a generation to discover, can be accurately ascertained—and what is more, its causes located and described—in a few years of research at a properly equipped scientific institution. Appropriations to the use of a Department of Agriculture are consequently investments which yield a direct return by adding to the productive capacity of the country, so that the farmer, when strengthening the hands of the Department is directly forwarding his own ultimate interests.

—Natal Agricultural Journal: Dec. 1909.

Science and the Planter.

Who, twenty years ago, ever thought of employing a mycologist or a chemist or entomologist on an estate ? If the matter had been suggested we should have been met with the old parrot-cry "We don't want a scientific man, we want a practical man." The old-fashioned planters of the early days looked askance when any word of scientific technology, to which they were then quite unaccustomed, were mentioned. Now such words as 'cambium,' 'latex,' 'nitrogenous plants' and 'Termes,' are quite familiar in their mouths as household words. This change from the rule of thumb or empiric system to the scientific or knowledge system marks an era in the commencement of a sound system of cultivation not only of rubber but of every other plant of use.

—H. N. Ridley, M.A., F.R.S., in "Agricultural Bulletin, Straits Settlements, and F. M. States." Nov. 1909.

Notes.

New Nitrogenous Fertilizers. The increasing demand for the two new fertilizers containing nitrogen extracted from the air—calcium cyanamide or nitrolim, and nitrate of lime—has led the Rothamsted authorities to make some experiments to determine the value of the new substances as against such old-established favourites as sulphate of ammonia and nitrate of soda. The crop selected was barley ; and as the upshot of the trials, which were carried on during 1909, Mr. A. D. Hall, the Director of the station, concludes that if any difference does exist between the effectiveness, nitrogen for nitrogen, of nitrate of soda, and nitrate of lime, or of sulphate of ammonia and cyanamide, it will be only a difference of 10 per cent. or less. That being the case, it should be the character of the soil and the relative price of the fertilizers per unit of nitrogen which should dictate the choice between them. We understand that trials on a very large scale with nitrate of lime are being made on certain sugar estates in the colony. Some trials have also been made with nitrolim. An interesting point has been noticed in one of these—a very marked diminution of insect pests in the crops immediately succeeding its application. This raises the question whether nitrolim, especially when containing some excess of calcium carbide, might not prove a valuable aid in combating pests with habits like those of *Castnia licus.* A comprehensive comparative series of experiments with sulphate of ammonia, dried blood, nitrate of soda, lime nitrates and nitrolim is being carried on on the Experimental Fields at the Botanic Gardens.

The Fertility of Partially Sterilized Soil. It is no new discovery that soil, when partially sterilized, acquires a remarkable fertility; but the explanation of the phenomenon has not, until now, been so easily given. Drs. E. J. Russell and H. Hutchinson have had the problem under investigation and their discoveries are full of interest. They found that the increased productiveness of the partially sterilized soil was due to an increase in the amount of *ammonia* present, and that that excess is the result of the increased decomposition of the substance of the soil by bacteria. It had already been ascertained by Hiltner and Stormer that bacteria increase after partial sterilization ; it is now shown that these bacteria are more potent in decomposing power, and that their sudden flourishing is due to the killing off, by *the partial sterilization*, of their natural enemies in the form of certain large organisms (*protozoa*)—microscopically

and comparatively large, of course—which exists in the untreated soil. These competing and destructive organisms are killed by heat and most of them by toluene—which was one form of sterilizer used in the experiments—and can then serve as food for the bacteria. Thus in two ways partial sterilization assists the tiny agents of beneficial decomposition. It will be noticed that the partially sterilized soil offers the plant not nitrate but ammonia as nitrogenous food material ; and this interesting deviation from the more ordinary course is still under investigation. In the tropics such partial sterilization in all probability occurs in naked fallows during the long dry season.

Medicinal Qualities of Grapefruit. In an article by H. P. D Kingsbury in the "Rural Californian" the medicinal qualities of grapefruit are set forth, and an interesting account of its introduction and growth in popularity are given :—

"The grapefruit like its cousin, the orange and the lemon, is possessed of marked medicinal qualities. It is chiefly valuable as a corrective of the stomach and digestive organs, and also as a tonic stimulant. A medicinal opinion from a widely quoted physician states : "The sharp stimulus of the grapefruit is the best thing to set the digestion in order for the day." Invalids find it the right thing to give tone to the system, and it is a sure preventive, when partaken of freely, of the enervation caused by climatic conditions. It possesses in a remarkable degree the virtues of quinine without producing any of its bad effects, and may be given with benefit in malarial fevers. Many use grapefruit as a relish with meals and the appetite is sure to be quickened by it. For medicinal purposes the entire fruit may be cut up into a pitcher and left to cool. A glass of this before meals and at bed-time, will prove an excellent tonic. Grapefruit marmalade contains all the good qualities of this fruit in the form of a most delicious preserve.

J. H. Wright says : "Probably no fruit of the citrus family has forced its way into the front rank of popular favour with more difficulty than the grapefruit. It is of East Indian origin, and from Asia it became diffused through the West Indies, and later into Florida and California. At the close of the Civil War the writer embarked in the foreign fruit trade, and has watched with interest the trade growth of this once discarded, but now popular, fruit. So popular has it become that it is looked on now as almost a necessity, not only as a breakfast dish, but it appears on the menus as a first course at many a

state dinners and social functions, besides being highly recommended by leading physicians as a great relief for Bright's *Disease, Rheumatism, Constipation, Malaria,* and many other kindred complaints, the acid of the grapefruit serving as an excellent tonic and appetizer, besides working favorably on the kidneys, more promptly than any other fruit acid. Even the *rind of the grapefruit is said to produce an excellent tonic* when boiled.

While grapefruit is said to have its origin in the shaddock, Sir Daniel Morris says " It is evident that there are several varieties, for the shaddock, as we know it, is usually larger than the grapefruit, is mostly pearshaped, thick-skinned, and when cut shows a pinkish color, while the perfect grapefruit is round, thin-skinned and juicy, with a white pulp." Between the years 1860 and 1870 small quantities of grapefruit began to make their appearance in the New York market, coming there from the West Indies, mostly in schooners carrying Abico oranges, pineapples, conch shells, etc. So limited was the sale that seldom did a consignment realize expense charges, the fruit generally finding its way into the hands of vendors who loaded their wagons and hawked the fruit about the city calling them ' California Orange,' 'Forbidden Fruit,' ' Paradise Fruit,' or using names best suiting their sale. Several hundred barrels of this fruit were shipped from New York to England in the early ' 70's but with no financial success.

Abnormalities in Hevea Seedlings:

In the last *Journal* a brief note was given on some experiments in the methods of planting Hevea seeds, and the percentage of germinations stated. It was observed that a very great proportion of the seeds that were sown vertically, with the micropylar end uppermost, produced twisted seedlings. These twists could be classed into two groups, one a simple knee-bend and the other a complete twist. Of the 722 seeds that germinated in this series, 508 seedlings had knee-bends, 149 made a complete twist, while 65 were apparently normal. For the explanation of these abnormalities, we cannot do better than quote from Mr. Petch of Ceylon, who has described similar abnormalities in Hevea seedlings in that colony :—" When the seed is planted in this position (*i.e.* vertically with the micropylar end uppermost) the radicle emerges vertically and bends over, usually towards the " lower " (or " grooved ") side of the seed ; and unless the seed is planted deeper than usual the radicle comes above ground before it begins to curve. The secondary roots are then produced in the air and may wither before reaching the soil. This is

the extreme case, but in all cases, even when the radicle does not emerge from the soil, the emergence of the looped shoot is considerably delayed, because it does not occur until the radicle has curved over so that its tip points vertically downwards and the secondary roots have been produced. During this delay all the parts that have emerged from the seed coat become much thicker than in normal germination. Since the slit between the leaf stalks is horizontal, the loop of the plumule must emerge from it horizontally and at right angles to the root. It then turns so that its two sides are in the same vertical plane. The tip is then pulled out of the seed, the loop straightens out and the whole shoot curves upwards and into the same vertical plane with the root. There is then formed a knee or an N-bend, according to the amount of curvature in the seedling before the plumule straightened. In many cases, the loop is held so firmly by the thickened leaf-stalks that it cannot pull out. The loop does not straighten out but the tip of the shoot emerges from the seed and curves upwards on the wrong side of the cotyledon stalks forming a complete loop. In fact completely twisted seedlings are comparatively common." In our experiments, 65 seedlings were apparently normal, and it was observed that some of them commenced with slight knee bends that subsequently straightened out. It is most probable that the seeds which form normal seedlings were planted not perfectly vertical, and consequently the first curve was not so rigid that it could not subsequently straighten out. It has been asserted by a planter in Ceylon, that these curved or twisted seedlings are adapted for planting in swampy land if the tap root is removed, for the mass of roots which spring from the knot provides a better growth than a sickly tap root would. As Hevea is recommended to be planted only in well drained land in this colony, if the best and most rapid results are looked for, planters will not adopt this method of sowing their seeds, but in case of where badly drained land is proposed to be planted in Hevea as an experiment this system of sowing the seeds vertically with the micropylar end uppermost might be worthy of consideration.

Planting Distances for Rubber.

The manager of the Bukit Rajah Estate reports that the best results have been obtained in tapping from trees 27 feet by 27 feet. In crowded fields the bark does not renew so thickly and the trees do not yield so much latex. Trees at Sunzei Binjai planted wide yielded 4 lbs. each, working out to 300 lbs. per acre.

—Agric. Bulletin S. and F. M. States. Nov. 1909.

Rice Cultivation.

During the past few years a very considerable rice industry has arisen in the colony, and in many districts, very satisfactory returns have been obtained. In 1908, some 38,000 acres were returned as being under rice which gave an average yield of 25 bags of paddy to the acre, while in 1909, 36,000 acres were cultivated in this crop and the returns were somewhat lower. The unsatisfactory season to a certain extent may have been responsible for some of the smaller yields, but lack of proper attention to such vital questions as selection of seed for planting, careful preparation of the land and choosing the proper season of the year for planting have, without doubt, tended to bring about the lessened returns. With a view to assisting cultivators of rice, the following short article has been prepared for the Rice Cultivation Committee of the Board of Agriculture by the Director, Science and Agriculture, and the Government Botanist, and if the instructions there given are closely followed, satisfactory results should be obtained :—

PREPARATION OF THE BEDS.

Land to be put into rice should be laid out in beds with dams 2 to 3 feet wide and 2 feet high between them. The beds should be carefully levelled and arrangements made for their drainage and irrigation. The most satisfactory arrangement we have found in our experience is one, whereby the irrigation trench runs across the 'tops' of the beds immediately outside the head dam, through which small wooden 'kokers' are placed in order that water can be admitted to any bed independently of the others. The beds are made to slope sufficiently with a shallow drain down the middle of each so that the drainage is accomplished at the ends of the beds away from the irrigation trench. This system of irrigation and drainage has worked most satisfactorily on the rice fields at the Botanic Gardens, and these fields should be visited by all who contemplate improvements in their rice cultivation in this direction.

In throwing up the dams between the beds, care must be taken to remove as little as possible of the surface soil from the beds, or otherwise, if soil is taken off too deeply, a heavy, frequently alkaline subsoil is reached, which will only give small yields. Poor yields are often the result of taking off too deep a layer of soil for making up unnecessarily high dams. The security of the dams must be carefully attended to, for proper attention to the dams is one of the most important duties of the rice cultivator.

CULTIVATION.

The best land for rice is a clay-loam with an almost impervious subsoil. It should be carefully forked or ploughed four to five weeks before the crop is to be planted. This forking or ploughing should not be deeper than about 6 inches or otherwise the subsoil may be turned to the surface, and the yields reduced. The depth to which land may be forked or ploughed varies with the locality, and experience soon indicates the correct depth to adopt. The first part of the land to be cultivated should, however, be the nursery. This should be carefully chosen and should be on the very best land, where a good supply of water can be obtained. Sufficient care is not usually taken in the choice of suitable nurseries. On this choice, particularly if the weather conditions are unfavourable, often depends the success or the failure of the crop, and therefore the selection of good land cannot be too strongly emphasized. The nursery should be flooded as soon as possible after forking and levelled ready for planting seed. During the four weeks that the seedlings are growing in the nursery the cultivator must turn his attention to the land for the general planting. It has to be forked or ploughed, levelled and prepared for the young plants that are to be transplanted. The breaking down of the soil after the forking is usually done by hoes or by means of primitive harrows, and levelling is accomplished by dragging a log of wood backwards and forwards, or by inverting the harrow and drawing that across the beds. The land should resemble 'drift mud' before it can be considered to be in a first class condition for transplanting, but this thorough breaking up of the soil should not be more than 4 inches in depth.

SELECTION OF VARIETIES.

Varieties of rice are very numerous and 200 of them have been experimented with at the Experimental Fields since 1903. The best varieties of rice cultivated in other rice-growing countries have been obtained and submitted to very careful comparative trials as to their yielding powers under conditions similar to those existing on the coast lands of the colony. From these varieties, three, viz. Nos. 75 (Suthrà dhán), 3 and 6, have consistently given better returns than the Creole varieties and large quantities of their seed paddy have been distributed free to numerous growers. These varieties are all long-grained, such as are demanded by the local rice market, and they all possess good milling qualities. The Agricultural Superintendent thus describes them :—

" Creole.—Grain long, very slightly tipped at apex with red spot, light green, awns absent; stalk dark green, very slightly tinged with purple. Growth medium to vigorous.

No. 3.— Grain long, light green, ends tipped, awns absent; stalk green with a faintest touch of purple. Growth vigorous.

No. 6.— Grain slightly tipped at apex, light green colour, awns absent; stalk dark green very slightly touched with purple. Growth medium to strong.

No. 75. (Suthrà dhán)—Grain long, light green with red tips, awns absent; stalk dark green tinged with purple. Growth medium to vigorous."

Nos. 3, 6 and 75 are all of the best type and apparently are closely allied to the Creole rice of the colony. Barley-grained varieties have also been experimented with, and small quantities are being grown experimentally in order to serve for seed should the condition of the market at any time demand a barley-grain. While fresh importations of other varieties will take place from time to time it has been decided that the best results are likely to accrue from selection in the different varieties that give satisfactory results. In 1909, a large number of variants have been chosen out from the Creole, No. 75, No. 3, and No. 6 as well as from other varieties. These will be submitted to careful trial, in order to obtain, if possible, better varieties than are on hand at present.

SELECTION OF SEED.

The local market damands a long-grained type of rice, and cultivators should be careful to select only such varieties as meet with ready favour with the millers.

The paddy distributed by the Board of Agriculture is practically pure to type but unless great care is taken in the selection of seed a rapid deterioration in quality may take place. A large number of growers go to the mills for their seed paddy. They pay but little attention to the quality of the seed selected and naturally the results are not as satisfactory as they should be. Others keep back paddy for planting purpposes, and here again little or no thought is taken as to selecting only the very best. The grower should always use the best possible seed for planting purposes. It should be a clean uniform sample and the individual grains should be well filled. Careful selection of seed paddy is a

matter of the utmost importance. Not, however, is it of importance to the grower alone, but also to the miller and the consumer. Mills can work a uniform sample of rice much cheaper than a mixed one, the product is more saleable, and as competition becomes keener the millers will naturally look to the most careful cultivator. Growers should commence to select their seed and the millers should see that their selection is along the right lines. The seed which is supplied by the Board of Agricultkre is distributed expressly for seed purposes. That which was distributed this year is intended to be increased sufficiently to be spread over a wider area next year. All growers that receive seed from the Board should reserve what they obtain from it for seed next year, and if they obtain more than they require they should offer it to the mills expressly for seed purposes. Seed selection is of paramount importance for the successful furtherance of the industry, and the sooner the present suicidal policy of using almost any sample of paddy, no matter how inferior, for seed purposes is completely suppressed the sooner will the general returns be increased and the quality of the paddy improved. One of the most promising signs of progress in the rice industry will be when growers obtain their seed paddy from others who make a speciality of growing rice of the best quality purely for sale for seed purposes.

SOWING OF SEED IN THE NURSERY.

Practically no rice is sown broadcast for the several crop in this colony. Seed is sown in nurseries and the general crop is transferred therefrom. Seed selected for sowing should preferably be placed in a bag and soaked in a trench for 24 hours. The bag should then be taken out and placed on dry land in the shade and covered down. The heat of the germination of the seeds causes them to burst, and even to sprout slightly. This soaking is advantageous because it makes it possible to see what proportion of seed germinates and thereby assists the grower in sowing a sufficient, but not wasteful, quantity of seed for his crop. It is also generally accepted that ducks prefer hard paddy and do not very often trouble that which has been soaked.

The seed beds in the nursery must be carefully prepared. They must be perfectly level. The levelling can best be accomplished by dragging a weighted board over the surface They must be moist and no water should be on the surface or otherwise the seeds will rot. Sprouted seeds should then be thinly broadcasted and the surface of the beds kept moistly by allow-

ing a small quantity of water to gently flow over them or by watering with cans. On no account must water be allowed to remain over the surface or the seeds will rot. When the seeds commence to grow and take root the water is allowed to remain and the larger the seedlings grow the deeper may be the water remaining on the surface.

TIME OF SOWING.

Sowing of seed in the nursery should commence at the end of March or early in April if the best results are to be expected. There can be no doubt whatever that the best crops are only to be expected when attention is given to the time of sowing the seeds. Growers seem to have recently attempted to sow rice all the year round, with the result that many of their crops have not paid for the labour expended upon them. *Low returns are largely the result of planting at the wrong time of the year.* If seeds were planted in the nurseries in March or April and the seedlings transplanted in April or May, higher general returns would be obtained and the condition of the rice industry greatly improved. It would be interesting to ascertain how much rice was practically thrown away last season by not adhering to the correct period for planting. A very large quantity was lost by drought shortly after the seedlings were transplanted into the fields and a still greater quantity was lost by the rice coming to maturity in the wet season. Where irrigation is not under absolute control, there is always a danger of loss of a crop by drought if planted out of season and the grower should always bear in mind that rice cannot properly ripen or be satisfactorily gathered in wet weather. Planting should be carried out so that ripening takes place in the dry season.

QUANTITY OF SEED NECESSARY.

The quantity of seed necessary to plant an acre is calculated to be from 8 to 10 gallons according to variety and to germination, and it should always be remembered that the sowings in the nursery should be 'successive,' *i.e.* sown in just sufficient quantities as there is labour available for transplanting. For example :—A man intends to cultivate 8 acres of rice, and will require say 80 gallons of paddy. This should not be all sown at one time, but should be sown in four lots of 20 gallons each, the first lot the last week in March or the first week in April, the second the following week and so on, so that the first two acres are planted up during the end of April or during the first week in May, the second in the following week, etc.

The reason for this is obvious. It is the most economical method of distributing the work. Seedling rice is ready for transplanting from the nursery in 4 weeks from the time of sowing and should be transplanted before it is 6 weeks old. After 6 weeks the plants commence to joint at the base and if then used for transplanting they remain stunted, do not tiller, and consequently give unsatisfactory returns. Sowing large quantities of seed at any one time, than can easily be handled is therefore an utter waste of time, trouble and money.

TRANSPLANTING.

When the seedlings in the nursery beds are about 4 weeks old they are ready for transplanting for the general crop. The plants are usually about 12 inches high at this time but no joints should be showing at their bases. The lifting of the plants from the nursery should be carefully carried out. It is not sufficient to simply pull the plants up—only bad results can be obtained if this is the practice. Before lifting, the soil around the roots should be loosened. This may be done by sticking the fingers of both hands round a quantity of plants so that a good 'double-handful' of plants can be taken up with all the mud adhering to the roots. After this is done the greater portion of the mud should be washed off from the roots and the plants put on one side and gathered into bundles of about 1,000 washed plants each. These are now ready to be carried to the fields for the planters, and to save time, they should be distributed at suitable distances over the beds so that the planters can readily obtain them. The planter unties a bundle, takes out a handful of plants, washes off practically all the soil attached to the roots, screws off the top three or four inches of the top portion of the seedlings and proceeds to dibble them in. The long straggling roots that are often noticed on rice plants ready for use by the planter are in practice always left untouched, but it is thought that it might be beneficial if they were also broken off in the same way as the top portions of the plants are removed.

The seedlings should be planted 2 to 3 plants in a hole at distances of from 9 to 12 inches apart. They should simply be pushed in the soft mud to the depth of one to two inches. The planting of 3 plants in a hole is considered to be the safer, and the distance between the plants depends upon the variety. For the Creole variety and Nos. 75, 3, and 6 any distances not less than 9 inches or more than 12 inches will give satisfactory results, but it has been found that the finer grained varieties experimented with, give better returns if planted about 6 inches apart. A selection of plants

as they are taken from the nursery and as they are being planted should be carried out as far as is practicable. Only the strongest plants should be used.

Experiments have been carried out at the Botanic Gardens in planting single plants to the hole. The results have shown that satisfactory returns can be obtained by this method and that a considerably less quantity of seed per acre is required, but the extra expense incurred in separating the seedlings and in planting them separately is not usually commensurate with the saving made in the seed paddy. It cannot, therefore, be recommended that the seedlings should be planted out singly, especially where irrigation is either impossible or where it is unsatisfactory. Three plants per hole is our general recommendation for this colony.

AFTER-CULTIVATION.

Plants after transplanting usually lie 'flat' for a day or two and then commence to stand upright. In a week, if the land has been well prepared, they will have taken root. In irrigatable areas, as soon as a bed has been transplanted, water should be cautiously run on and its depth regulated, but in any case it must not be more than 2 inches deep until the plants have taken root. The rice is now kept irrigated until the ripening stage is reached, and the depth of the water should be from 2 to 3 inches as a minimum to 5 to 6 inches as a maximum, the depth being regulated according to the growth of the plants. It is estimated that a crop of rice in this colony, to give the maximum returns, requires from 12 to 18 acre-inches of water per year according to the season, in addition to the rain that falls. Planters of non-irrigatable rice lands are wholly dependent upon the season for satisfactory returns and therefore they should be most particular to adhere to the proper sowing and planting season of April and May.

Two weedings should generally be given to a rice crop after it has been transplanted. These are usually given in the early period of growth, for transplanted rice soon commences to tiller and therefore satisfactorily keeps down weeds.

MANURING.

In British Guiana applications of manures are not given to rice. Leguminous and other weeds are allowed to cover the beds after the rice is cut, and this material is usually either forked or ploughed in. It is possible that at a later date it will be of advantage to sow leguminous crops in the 'off' parts of the year to be forked or ploughed in as green dressings.

Where rice becomes 'lodged' (or 'laid') it is evident that the land is sufficiently rich in nitrogen to grow large quantities of straw, and that nitrogenous manures are not required. After continuous cultivation for some years, the readily available nitrogen may become exhausted. Experiments at the Botanic Gardens indicate that phosphates may be desirable as manure for rice and that potash will be required after a few years of continuous cultivation. Bush water contains a relatively large quantity of nitrogen and potash, and where this is used for irrigation it may not be necessary to consider the application of any artificial manures except possibly that of phosphates. Applications of lime are not advisable. A considerable waste of rice straw is occasioned every year by burning, and it would be worth while considering whether this could not economically be made into manure to be used in the nursery beds, for it is generally recognised that the nursery should be manured wherever possible.

In some rice-growing countries, especially in Japan, the question of manuring is regarded as of great importance and numerous researches are being carried on with regard to it. Preference is given to applications of vegetable composts, animal manures, and of other organic substances. The application of bone dust has been found profitable. The investigations however are showing that on land deficient in nitrogen and where the irrigation waters supply but little nitrogen, application of sulphate of ammonia, of lime-nitrogen and, in places, of sodium nitrate are efficacious in materially increasing the yield of the cereal.

PERIOD OF GROWTH AND REAPING.

The period of growth varies with the variety. It is usually about 4 months, but may extend to as much as 6 months. Several early maturing varieties have been experimented with, and it has been found that whereas they retain their power of early maturity during the first one or two crops, they later adapt themselves to the conditions of the colony, and take about the same period to reach maturity as the local varieties. Early maturing varieties usually give a smaller total crop, and the returns of paddy per acre are generally less. If it is desired to plant early maturing varieties it will be found necessary to import fresh seed from its country of origin at short intervals.

As the heads begin to change colour and the grain reaches the 'dough' or 'ripening stage' the irrigation water should be entirely run off. Ripening now takes place, and it is essential that the beds

should be kept quite dry or otherwise the proper degree of hardness of grain is not obtained. The ripening takes from two to three weeks and when the grain is full and sufficiently mature it is cut by hand. In India, it is the common practice when the standing crop is fully ready for reaping to 'fell' it flat to the ground with large bamboo poles, for it is thought that reaping is thereby greatly facilitated. This practice might be given a trial in this colony, where the rice has not been 'laid' by rain or wind storms.

The cut rice is either beaten out immediately or bound into sheaves and left for a day or so on the beds or upon the dams, or 'stooked' (or 'shooked') up in the fields. The different methods appear to differ with the varieties grown and also upon the degree of ripeness when cut. Some varieties have to be threshed out as soon as possible or otherwise a considerable quantity of paddy is lost, while with other varieties the grains adhere strongly, and then it is an advantage to tie up the rice into sheaves and leave them on the dams or to make 'stooks,' as it thereby dries and threshes out better. It would appear that if there is any uncertainty as to weather, 'stooking' would be preferable to leaving the sheaves thrown on the dams.

THRESHING AND WINNOWING.

Threshing is done by hand either over a cross-bar of wood or on a sheet spread on the ground, or by trampling by oxen. Winnowing is usually accomplished by hand. Winnowing machines are being used by some growers, and if their efficiency were generally recognised it is probable that their use would become more common. Where a single grower might not be justified in purchasing a winnowing machine, a few growers combined together might have sufficient rice to warrant its purchase. Steam threshing machines could not under the prevailing conditions of rice culture be used to advantage in this colony as means of transport are not available, nor could such machines work satisfactorily in the fields themselves.

All rice after it has been threshed out and winnowed should be stored in a dry place, as far as possible away from the reach of vermin. Rats and other vermin should be destroyed if they become at all numerous.

YIELDS.

The average local yield is about 21 bags of 120 lbs. of paddy. The average returns for the last twelve years is shown in the following table :—

Year.	Yields in bags of 120 lbs. of paddy per acre.	Rainfall inches.
1898-1899	18.4	49.9
1899-1900	16.9	52.7
1900-1901	20.0	88.9
1901-1902	20.7	81.3
1902-1903	18.5	94.5
1903-1904	19.8	99.2
1904-1905	19.2	101.1
1905-1906	18.5	74.1
1906-1907	28.4	112.8
1907-1908	23.0	126.3
1908-1909	25.4	91.1
1909-1910	22.1	100.5
Means 1898-1910	20.9	89.36

The table shows that on the whole the average returns are not governed by the annual rainfall. The yield depends far more on the distribution of the rain during the year, and especially during the crop season, than on the total precipitation. It varies with the seasons in different districts and yields of 35 to 40 bags are not uncommon. With attention, the average yield ought to be considerably raised. In some countries the average yields are stated to be from 60 to 80 bushels per acre which is equivalent to 24 to 32 bags of 120 lbs.—yields in excess of the local ones. In India from 15 to 20 bags are reported as being obtained at Experiment Stations, whilst the general yields are only from 9 to 14 bags per acre according to land, climate, and mode of cultivation. In Burma the average yield is said to be 14 bags per acre. But rice-growers in British Guiana with average yields of 21 bags per acre cannot, owing to the higher value of labour, compete commercially with the yields of 9 to 14 bags obtained with the cheap labour of India and Burma.

ENEMIES.

Birds are the chief enemies to the rice crop of the colony. Ducks destroy a large quantity of paddy sown in the nurseries but they prefer hard paddy and therefore the damage can be reduced to a consid-

erable extent by soaking the seed before sowing. Many other kinds of birds feed on the rice during the growing season or as it is ripening. Their ravages can be kept down to a great extent by scaring.

The rice bug and a small sucking fly are common insect pests; but their attacks have fortunately up to the present been localized. Recently, attacks by a fungus have been noted. This turns the paddy a dark-brownish colour and renders the rice grain opaque. This disease is being investigated at the present time.

SUGGESTIONS FOR IMPROVEMENTS.

A certain area should every year be set aside by every rice grower on a moderate scale for seed paddy for the next crop. The best land should be chosen and only the best paddy sown. It would be of advantage if only seed obtained from the Board of Agriculture were this year sown in these specially selected plots. This rice is practically pure, and would constitute a good sample to commence with. Before sowing in the nursery, it should be picked over by hand in order to remove any bad grains. In every sample of rice there are always some bad grains and these should be removed if it is being used for the special purpose of raising seed for the next year. All black grains should also be picked out, as they tend to spoil a sample of yellow paddy, and they soon increase to such an extent that the paddy can only be classed as 'mixed.' When these specially selected rices come into ear, they should again be gone through and all the heads having undersirable characters should be cut out. All red-grained rices, black rices, and barley rices should be removed. If this is done, an excellent sample of paddy will be obtained for the next sowing and a more uniform crop will result, whilst, most probably, increased yields and an improvement in the paddy to be offered for sale will be accomplished. If every grower would attempt to improve the rice to be used for seed-purposes, a great improvenent would soon result and rice of a much more uniform character would be obtained. Increased yields and increased prices for any kind of crop can only be obtained by a careful attention to the selection and propagation of material for seed purposes. Rice is in need of just such care, if better results are to be looked for. The Board of Agriculture supplies pure strains of high class paddy. They should be made the starting point for growers to improve their seed paddy and thereby increase their returns and their profits.

J. B. HARRISON.
F. A. STOCKDALE.

Rubber in the North Western District.

The following is extracted from a report by the Agricultural Instructor-in-charge of the Rubber station at Issorora, on a visit to some farms on the lower Barima :—

These farms were visited between the 14th and 18th December, and between the 20th and 23rd December, 1909.

The soil on which these farms are situated is composed of rich pegass, which is so loose in texture that but little tillage is required, and the cost of cultivation is therefore greatly diminished.

This soil seems well adapted to the growth of the *Sapium Jenmani.* The Hevea, too, does well, but not quite as well as the Sapium. Whether this superiority in the early stages will be maintained in future growth has yet to be ascertained.

Fine specimens of 3 to 3½ year old heveas are to be seen on Grant A. The rubber trees on this grant are all fine healthy types, but for want of attention, they are for the most part taken over by bush, with vines running up the trees. A start, however, has been made to give the trees a chance of showing up, for a part of a field, 3½ acres in extent, which had been lopped down, was shown to me, and the contrast of that and the other part of the field was striking.

Should this system of cleaning up be done throughout this grant, and is continued, the result will be a fine specimen of a rubber plantation. Catch crops are also planted between the rubber, except where the land is too old, 40 acres being under tannias, eddoes, plantains, and yams.

Grant B has also fine specimens of *Sapium Jenmani*, but apart from the pruning of trees, this grant seems to have been neglected. A start is just being made to restore it to cleanliness.

Grant C is all that can be desired, except in the matter of pruning. Practically all the lower whorls of branches have been removed, just leaving a few at the top. This method may be a good one when carried out with discretion, but in the case of the average farmer of the North Western District it is better performed in the piecemeal manner (*vide* "Hints on the Pruning of Sapium" in the *Journal of the Board of Agriculture*, Volume No. II, p. 92) This method I demonstrated, and gave the reasons for so doing.

I pointed out the evil effects of the system of elaborate pruning. One tree I was able to use as an illustration why the above method was harmful, for it had quite withered up.

Among the *Sapium Jenmani* on Grant C are planted Coffee trees. The rubber trees are only 14 feet apart, instead of 20 feet; their roots spread to a considerable distance; and the trees form dense shades. I pointed out the mistake made in planting coffee plants between closely planted rubber.

I cannot say much about the rubber trees on Grant D, as these have only recently been planted out. They are put at a good distance, 18 feet apart. Scale insects have already attacked them, for which I recommended rosin compound. The coffee and cacao are also small trees. Lessons in pruning were given, both in connection with rubber, coffee, and cacao.

On Grant E are 600 *Sapium Jenmani*, but these are spontaneous plants, and consequently are too close together. I recommended the removal of some of them. This grant is very badly kept indeed.

Grant F possesses about 800 rubber trees. These are healthy-looking trees but quite overrun with bush. I discovered black scale insect on a few of them, and recommended the use of rosin compound, giving directions for making it, and applying the mixture.

The number of rubber trees on Grant G is not known, but an area of 4½ acres is under cultivation.

A few rubber trees are also to be found on Grants H and I. One of the rubber trees on Grant H was so covered with the black scale that I instructed the holder to have it removed and burnt.

Cultivations on which the black scale insect is to be found are *viz*:—Grants A, F, H and I. I have pointed out the necessity of keeping this insect in check.

The greater number of these holders are planting permanent crops, and where there were none I impressed on those farmers the necessity of establishing permanent plantations.

In this report, I have only given the acreage actually under cultivation, but in addition to this there are on some farms great tracts of land left to rest for one year, as they have ceased to produce provisions. As it is the system obtaining in this district, when land is newly taken in, to take off 3 crops of corn, then 4 crops of

tannias or 2 crops of yams—in which case when yams follow the corn, tannias follow yam—I advised that before the last 3 or 4 crops of any provisions be taken off, some permanent plant, *viz.* cacao, coffee, or rubber, be planted, and then the 3 last crops planted between. In this way, I think much of the land now lying abandoned could be turned to good account.

Whilst visiting the farms I found on most of them where corn was cultivated, a fungus disease.

A specimen of this disease I forwarded to the Assistant Director of Science and Agriculture, who identified it as the corn smut fungus *Ustilago maydis.*

W. H. M.

Coal Tar or Stockholm Tar?

"The recommendation that coal tar should be used for covering (pruning and other) wounds (in trees etc.) does not meet with the approval of Ceylon planters. From the mycologist's point of view Stockholm tar is too evanescent. I am aware that it has been universally recommended for tea, but there do not appear to be any definite comparative experiments on the subject . . . I have certainly seen coal tar used in branch canker on tea without any injurious effect. Either will kill the green bark if applied to it, and in this respect Stockholm tar is liable to do most damage because it is more fluid and therefore most likely to run. Stockholm tar is a poor protection against fungi, and in one case, in *Hevea,* fungi grew on the cut surface three weeks after its application. Moreover, practice favours coal tar. W. J. Bean of Kew, writing on pruning in the *Gardeners' Chronicle,* April 21st, 1906, states :—'The virtues of ordinary coal tar—not Stockholm tar—as a dressing for cut surfaces are not generally known. All the raw places left by removing branches or stumps of branches should be immediately covered with this antiseptic substance, and the coating should be renewed as often as is necessary till the wound is covered with new bark. The best armour that a tree can have to protect it against fungoid enemies is that which Nature has provided it, *viz.* its bark. But when accident has produced a flaw on the armour the most efficient substitute is coal tar.'"

—The Ceylon Government Mycologist in The "Tropical Agriculturist." Nov. 1909.

Canning in the Home.

The great secret of 'canning' or preserving lies in complete sterilization. The air we breathe, the water we drink, all fruits and vegetables, are teeming with minute forms of life which we call bacteria, or moulds, or germs. The germs are practically the sole cause of decomposition or rotting. The exclusion of air from canned articles, which was formerly supposed to be so important, is unnecessary provided the air is sterile or free from germs. The exclusion of air is necessary only because in excluding it we exclude the germs. In other words, air which has been sterilized or freed from germs by heat or mechanical means can be passed continuously over canned articles without affecting them in the least. If a glass bottle be filled with some vegetable which ordinarily spoils very rapidly—for instance, string beans—and, instead of a cork it is stoppered with a thick plug of raw cotton and heated until all germ life is destroyed, the beans will keep indefinitely. The air can readily pass in and out of the bottle through the plug of cotton, while the germs from the outside air cannot pass through, and their spores or seeds are the only causes of spoilage that we have to deal with in canning.

Germs which cause decay may be divided into three classes—

YEASTS, MOULDS, AND BACTERIA.

All three of these are themselves plants of a very low order, and all attack other plants of a higher order in somewhat the same way. Every housewife is familiar with the yeast plant and its habits. It thrives in substances containing sugar, which it decomposes or breaks up into carbonic acid and alcohol. This fact is made use of in bread making as well as in the manufacture of distilled spirits. Yeasts are easily killed, so they can be kept out of consideration in canning vegetables. Moulds, like yeasts thrive in mixtures containing sugar, as well as in acid vegetables such as the tomato, where neither yeasts nor bacteria readily grow. Although more resistant to heat than yeasts, they are usually killed at the temperature of boiling water. As a general rule, moulds are likely to attack jellies and preserves and are not concerned with the spoiling of canned vegetables. The spoiling of vegetables is due primarily to bacteria.

Bacteria are also much more resistant to heat than yeasts. They thrive in products like milk, and in meats and vegetables rich

in protein, such as peas, beans, etc. All known species of moulds require air in which to work. This is not true of bacteria, certain species of which will live and cause vegetables to decompose even when no air is present. When these particular species are present the exclusion of air is no safeguard against decay unless the vegetable is first thoroughly sterilized. Bacteria are so small that they can only be seen with a microscope, and they reproduce themselves with amazing rapidity. One bacterium under favourable conditions will produce about

TWENTY MILLIONS

in the course of twenty-four hours. Accordingly certain vegetables spoil more rapidly than others, because they furnish a better medium for bacterial growth.

The reproduction of bacteria is brought about by one of two processes. The germ either divides itself into two parts, making two bacteria where one existed before, or else reproduces itself by means of spores. These spores may be compared* with seeds of an ordinary plant, and they present the chief difficulty in canning vegetables. While the parent bacteria may be readily killed at the temperature of boiling water, the 'seeds' (spores) retain their vitality for a long time even at that temperature, and upon cooling will germinate and the newly formed bacteria will begin their destructive work. Therefore it is necessary in order to completely sterilize a vegetable, to heat it to the boiling point of water and keep it at that temperature for about one hour *upon two or three successive days*, or else keep it at the temperature of boiling water for a long period of time—about five hours. The process of boiling upon successive days is the one that is always employed in scientific work and is much to be preferred. The boiling on the first day kills all the moulds and practically all of the bacteria, but does not kill the spores or 'seeds.'

As soon as the jar cools, these spores germinate and a fresh crop of bacteria begins work upon the vegetables. The boiling upon the second day kills this crop of bacteria before they have time to develop spores. The boiling upon the third day is not always necessary, but is advisable in order to be sure that the sterilization is complete. Among scientists this is called fractionable sterilization and this principle constitutes

---

*'Compared' only to be contrasted. There is an essential difference between the spores of bacteria and the "*seeds of an ordinary plant.*"—*Ed. J. B. of A.*

If the housewife will only bear this in mind, she will be able with a little ingenuity to can any meat, fruit or vegetable.

Even after sterilization is complete the work is not yet done. The spores of bacteria are so light that they float about in the air and settle upon almost everything. The air is alive with them. A bubble of air no larger than a pea may contain hundreds of them. Therefore it is necessary after sterilizing a jar of vegetables to exclude carefully all outside air. If one bacterium or one of its spores should get in and find a resting place, in the course of a few days the contents of the jar would spoil. This is why the exclusion of air is an important factor; not because the air itself does any damage, but because of the ever-present bacteria.

—J. F. Breazeale in U.S. "Farmer's Bulletin (No. 35.)"

Poultry and Corn (Maize.)

A very common mistake made by poultry keepers is that of feeding their herds on too much corn (maize). Too much maize is not good for fowls, as it brings on liver disease sooner than anything we know . . . Poultry keepers use corn (maize) because it is a cheap food, and fowls seem to prefer it to any other, but they have to pay very dearly for their fancy, and only the bare, sad facts will convince some of the danger of using too much. A little corn for a change does not hurt the fowls, especially in the cold weather, but as a regular diet it should never be used.

— Journal of the Jamaica Agricultural Society. Jan., 1910.

To Evict Insects.

To expel subterraneous insects and worms, mix "Vaporite" with the soil before making up the nursery beds or putting out the plants. It should be applied at the rate of 1½ oz. per square yard, and well mixed with the soil some three or four days before planting.

—Ceylon Government Entomologist: in "Trop. Agriculturist," Jan., 1910.

Robusta Coffee in Java.

The following extract from the Philippine Agricultural Review, Vol. II., No. 10 is of interest:—

"A new variety of coffee known as "robusta," which was discovered some years ago growing wild on the estates in Africa, is being grown very successfully in Java. Inasmuch as no satisfactory results were obtained from growing the plant in Kongo region some specimens were sent to the Botanical Gardens at Brussels and from there a number of plants were sent in Wardian cases to Java in 1902. The results of the cultivation of this coffee have been excellent and it is reported that in several cases the success of this cultivation has saved old coffee estates from ruin. It is said that it thrives on ground where Arabian and Liberian coffee have ceased to yield a satisfactory product.

Ordinary Arabian coffee yields its first crop at four years, such yields being about 4 piculs* per buow, (1 buow=1¾ acres). The robusta coffee planted in east Java yields after three years from 10 to 12 piculs per buow and on some estates during the past year five-year-old trees have procuced 20 to 25 piculs per buow, this being regarded as a record yield. Robusta coffee trees are planted about 6 feet apart and topped at about 5½ feet high. Young plants require shade. The bean is small and for the first two crops rather lacking in the aroma usually found in coffee. The later crops, however, appear to improve in taste and aroma.

The Netherlands Indian Government is encouraging the cultivation of robusta coffee by establishing nurseries in different districts and distributing young plants free to the natives for planting. Seeds of the robusta coffee have been sent to the coffee estates in Brazil for experimental purposes, the results of which are not yet known. The output of robusta coffee for 1908 is given as 1,600 piculs. The price quoted for this article is $14.07 United States currency per picul. Only small quantities have as yet been exported."

Robusta coffee is now being planted extensively as a catch crop between rubber in Java, and experiments in this direction are being commenced in this colony. It is stated that in some countries it is rather liable to leaf diseases, but this has fortunately not yet been the experience of cultivators of this variety in this colony.

* A picul=136 lbs.

Cassava.

In the course of a series of articles on "Tropical Industries," the *Queensland Agricultural Journal* publishes an account of the cassava or "American potato," as it is somewhat obscurely called 'down under'; and although much of the information given is familiar to our readers, some points of interest are made.

CULTIVATION.

The planting and cultivation of the cassava plant is as simple as for arrowroot, but it should only be grown near the coast where atmospheric moisture is found even in the absence of rain. It is only during the first two months after planting that a good rainfall is necessary; after that the plant will thrive without any further showers.

The soil must be rich, well-drained and deeply worked. Wet ground must, above all, he avoided, since too much moisture causes the roots to rot. The plant is reproduced in the same way as sugar-cane—by cuttings from the stem. Only the tough wood of the full-grown stems should be used for cuttings. These, which should be about 1 foot in length, are laid in the furrow and covered as is done with sugar cane cuttings. On very rich land the rows should be from 3½ to 4 feet apart. So quickly do the cuttings grow that after two months the shoots will attain a height of 1 foot, and six, or at most eight weeks later, the plants will have taken such possession of the ground as to prevent the growth of weeds, and thus fur'her cultivation becomes unnecessary. In about eight months after planting the tubers are ready for digging, but they will take no harm if left in the ground for a year, and taken up as required.

The resulting crop on rich land or with good fertilizers will amount to from 6 to 8 tons per acre, and the digging can be done for about 2s. per ton. The following estimate of cost of producing a crop and profit is furnished by a cassava planter in Florida :—

	£	s.	d.
Ploughing per acre		6	0
Harrowing per acre		1	5½
Cuttings planted 4 ft. x 4 ft.		6	11
Planting per acre		4	0
Six cultivations		8	5
Four hoeings		16	0
Fertilizer (if reqd.) 350 lbs. per acre at £5 per ton. ..		16	0
Digging and hauling (say 1 mile)		5	0
	£3	3	9½

Value per ton £1. To pay expenses a crop of 4 tons is required. Therefore on an 8-ton. crop, the net return per acre is about £4 16 2½.

HARVESTING.

The stems are first cut above the ground, when the tubers are drawn out. Any which break off are afterwards taken up with a hoe or ploughed out, or the whole crop may be ploughed out. The tubers are then carted to a shed, where they are separated from the stems: these latter being preserved for sets for the next planting.

Cassava being a very exhausting crop, it should not be planted more than two or three times in succession on the same land.

PREPARATION OF THE FARINA.

The cassava farina constitutes the tapioca of commerce when heated on hot plates, which causes the grains to swell, many of them bursting, and the whole agglomerating into irregular masses or lumps. The finest are sold as tapioca, the intermediate samples being used for starch. There are large plants for the making of tapioca, but much of the tapioca of commerce is now produced with simple appliances.

The roots of the cassava are well washed and peeled to get rid of as much of the poisonous principle as possible. If they are left for a couple of days in water, the skin comes away easily. They are then passed through the grating machine, continuous streams of water being poured upon the grated mass to separate the starch from the fibre. When the starch has settled in the vats, the water is gradually drained off through a series of taps, one above the other. More water is added, and the starch well stirred, and again allowed to settle, the water being drained off as before. This process is continued until the starch is perfectly white. When the surface is dry, it is cut out in lumps, which must be thoroughly dried on airy shelves before they are placed on horizontal tin plates beneath which is a hot-air pipe in which a particularly gentle heat is maintained. In Europe, tapioca is usually sold in the form of flakes, which are made by placing the lumps of starch, in a nearly dry state, in deep pans where they are subjected to strong heat and are continually stirred about until they have acquired the desired form.

In the Straits Settlements

PEARL TAPIOCA

is made in the following manner:—

The dried masses of starch are placed in a hand mill where they are reduced to the size of No. 4 shot. From the roof of the factory hangs a coarse cloth, like a verandah 'hanging-mat' or blind, kept spread out by a crosspiece of wood so that it looks like a canvas boat. The cloth is filled with the shot-like starch, and it is then swung backwards and forwards by two men. Under this treatment the grains are ground into perfectly round little balls which require to be once more warmed for half an hour by gentle heat in a pan, when the process is complete. In fine weather they are often exposed for half a day to the sun's heat.

In the cassava plant we have a raw material which yields a starch of the highest purity, possessing all the characteristics of the maize product, the cost of production being one-fifth that of maize. In experiments made in Florida with fresh roots, the average percentage of starch was found to be 24.75 and with Jamaica roots 26.23; 4 per cent. of cane sugar was also recovered from the liquor. Compared with maize and potatoes, upon which practically the whole world depends for its supply of starch, the average yield of starch is as follows:—Maize 53; potatoes 18; cassava 25 per cent. An acre of ground yields 40 bushels of maize (on an average) which in turn yield 1,200lb. of starch, whilst the same ground will yield 10 tons of cassava, yielding 6,720lb. of glucose and 5,000lb. of starch, and it is possible to reach a much greater amount. In Queensland, 12 to 14 tons of cassava roots could be raised on an acre of our rich, virgin, northern scrub lands.

A plant has been devised by means of which the whole 25 per cent. of dry starch can be obtained, and this plant can be worked

25 PER CENT CHEAPER

than the potato starch plant, the process being perfectly automatic and continuous. The plant will work up 100 tons of roots per day of ten hours. The entire process occupies three days, when the starch is ready for market, while maize, under the most favourable conditions, requires from twelve to fourteen days.

It is unquestionably true that as a food for farm stock, cassava comes nearer supplying a perfect ration than any other concentrated food produced on the farm. Experiments in feeding stock have proved it to be the best and cheapest ration which can be used for fattening purposes. The most astonishing fact, however, is the great difference demonstrated between the cost and the result of

feeding corn and feeding cassava; the difference being almost two-thirds in favour of the latter.

Honey Cakes.

The simplest honey cake is the 'honey ginger-snap.'

One pint of honey
¾ lb. butter
2 tea-spoonsful ginger.

Boil together for a few minutes, and allow it to get nearly cool. Add enough flour to make a stiff dough and roll out thin; cut into round cakes and bake quickly.

Another simple cake is the 'honey cookey.' The recipe is given for a large quantity because they will keep indefinitely, and they are nice to have in the house all the time for the children to eat between meals. If they are wanted in smaller quantities the receipt can be reduced a half or even one-quarter.

One pint honey
One quart sour milk
1 tea-spoonful soda.

Mix well together and add sufficient flour to make a soft dough. Roll moderately thin and cut into round cakes. Bake in a slow oven to prevent burning.

A richer 'cookey' is made by the addition of butter and eggs.

One pint honey
½ lb. butter
4 eggs
½ pint butter milk or clabbered cream
1 quart flour
1 tea-spoonful soda.

Mix the honey and the butter and the eggs well, and add the butter milk. Sift in the flour and soda and mix well. Mix in enough flour in addition to the quart to make a cookey dough that will roll out well without sticking; cut in round cakes and bake in a slow oven.

Mrs. B. R. Winslow, in "Gleanings in Bee Culture," Vol. XXXVII, No. 14.

Corn Smut.

Specimens of 'smut' of corn have been from time to time submitted by the Agricultural Instructor-in-charge of the rubber station in the North Western District, and by cultivators in other districts of the colony. The object of this brief note is to draw attention to this disease, to warn farmers against neglecting it, and to suggest simple methods for its control.

Frequently in fields of corn, plants are noticed having conspicuous 'bumps' or 'boils' on the leaves, stems, etc. and more commonly the ears are seen to be curiously transformed. Either the top of the ear is covered with large whitish swellings which later develop into a black *sooty mass* or the whole ear is transformed in a similar manner. Instead of well-formed kernels a black useless ear is produced. This is due entirely to the effects of a fungus (*Ustilago maydis.*) The mycelium or vegetative part of the fungus infests the part of the plant affected, and if this happens, as is most commonly the case, to be the ear, the grains fail to reach maturity or are entirely destroyed by the formation of spores.

The spores appear at first as dark brownish-green masses, but as they mature these masses burst the enclosing tissues of the corn plant and the spores escape as a sooty powder. They can then be readily scattered by the wind and infect other plants.

A certain loss of crop results, but by far the greatest danger lies in the fact that the spores retain their power of germination for a considerable time and can infect any immature part of the host plant throughout its growth. It is obvious, therefore, that all diseased ears should be collected if possible, before the spore masses burst, and be carefully burned. On no account should corn that has been mixed with smutted ears be used for seed purposes, or otherwise the young plants are almost certain to be infected, and no smutted plants should be allowed to remain on the land or be made into manure. If these simple precautions are taken this disease can readily be controlled, but cultivators cannot be too careful in the selection of well-formed ears for seed purposes from fields that have not been affected by the disease.

It would appear that the disease has been known to occur in the colony for a fairly long time and that in some years it is much worse than in others, but this should not prevent cultivators from taking

every precaution for its control, especially as it has not yet been ascertained what exact amount of damage is really being done.

REMEDIAL MEASURES.

The remedial measures may be summarized as follows :—

1. Cut out and burn all diseased heads, if possible, before they become 'sooty.'

2. Search for and cut out and burn all plants that have suspicious-looking boils upon them.

3. Use only good ears for seed purposes and from fields which have contained no diseased ears.

4. In badly infested districts soak all seed corn before planting in a 1% solution of copper sulphate before sowing, as this will destroy all fungus spores that may be attached to the seed coats.

5. Do not leave diseased plants that have been cut down on the land and do not make them into manure. *They must all be burned.*

F. A. STOCKDALE.

Charcoal and Ducks.

The trials showed that charcoal in one form or another is essential in the profitable fattening of ducks. It appeared to keep our ducklings healthy and enabled fattening to be continued with profit for a much longer period than when charcoal was not allowed.

Pen No. 1 was allowed no charcoal, pen No. 2 was given an unlimited amount of rough charcoal, while in the case of pen No. 3 powdered charcoal was mixed with the mash at the rate of one-fifth charcoal to four-fifths of the other ingredients, the charcoal being thoroughly incorporated with the meals before they were moistened. The results showed an increase per head in four weeks in pen No. 1 of 1 lb. 5 oz., in pen No. 2 of 2 lbs. and in pen No. 3 of 2 lbs. 2 ozs.

—Journal of the Board of Agricultural (England). March, 1910.

Hints, Scientific and Practical.

"Scorching" explained. The passage of dissolved substances into the plant takes place by the purely physical process of osmosis, the walls of the root-hairs (which consist of single elongated cells) acting as semi-permeable membranes through which water or salts will pass independently, according to the relative concentration of the solutions inside or outside the cell. Should the cell sap be more concentrated than the soil water outside, pure water will pass through the wall until a certain osmotic pressure (causing turgor in the plant) is reached, which varies with the concentration. If, on the contrary, the soil water becomes more concentrated than the cell sap, water will leave the cell, the plant will become flaccid, and even die if the withdrawal of water be too great. It is in this way that plants become "scorched" or "burnt" by too concentrated solutions of any kind of soluble salts, such as are formed when a little soluble manure, salt, etc., falls upon the surface of a leaf.

—Mr. A. D. Hall, M. A., F.R.S., in "Fertilizers and Manures."

Garden Manures. In an ordinary way gardens require little artificial fertilizers, since they receive a superabundance of stable manure until the soil often becomes over rich in nitrogenous residues. Under such conditions the only fertilizer wanted will be some form of phosphatic manure, and this is very desirable to induce a properly balanced growth in the crops. Superphosphate may be used on the loams, basic slag on the strong soils, steamed bone flour and phosphatic guano when the soil is sand or gravel, and about ¼ lb. per square yard of one of these fertilizers should be dug in with the farmyard manure on those portions of the ground which come to be dunged in the usual rotation. . . . . The compound garden manures sold under fancy prices should be avoided: though good fertilizers enough, their cost is excessive even considering the small parcels in which they are sold. Where stable manure is not available and a mixed fertilizer is required, nothing is better than a good Peruvian guano with 6 or 7 per cent. of nitrogen. In such circumstances the humus of the soil should be maintained by digging in as much organic matter—weeds, grass clippings, vegetable refuse, etc.—as possible.

—*Ibid.*

Fertilization. In the great majority of flowering plants the ovules are enclosed in an ovary. The pollen grains fall on the stigma and there germinate. The pollen-tubes find their way thence—down the inside of the style when one is present—into the ovary, and so to the micropyles of the ovules. Seed does not form, nor, as a rule, does fruit ripen, till after this has taken place, and, when it does not occur, the ovary usually withers and the ovules shrivel up. Nevertheless, seedless fruits are known, as in the case of the banana, pine-apple, and certain oranges, and it is quite possible that horticulturists may be able to establish stoneless cherries and plums, coreless apples and pears, blackberries and raspberries containing nothing but pulp, and large grapes as free from seeds as the small grapes which grocers call 'currants.' But in all such instances the plant can be propagated only by cuttings.

—" Elements of Agriculture " by W. Fream, L.L.D.

The "Water-table." Of the rain which falls upon the surface of the ground some flows on this surface to the rivers and is carried to the sea, while the rest soaks into the ground (except that which is evaporated). The amount which is taken up by the ground depends, other things being equal, upon the permeability of the materials which form the upper part of the land. We thus speak of rocks as being *pervious* or *impervious*, though these terms are used relatively, no rock being absolutely impervious to the passage of water. Clays are the principal rocks which are relatively impervious, while sands and limestones are relatively pervious. Should the ground be practically flat, the underlying materials must eventually become *saturated* and the surplus water will then gradually soak away seaward or be restored to the atmosphere by evaporation; but when the ground is uneven, the rain which has been absorbed at a higher level may appear at the earth's surface again at a lower level in the form of springs . . . . As more and more water is added, the *saturated portion* of rock will become more and more extensive, and at last the upper surface of this saturated rock will reach the ground, where springs will then be formed. The upper surface of this saturated portion will not be a plane surface parallel with the plane of stratification, but a curved surface rising from without inward, for the water escapes more rapidly from the parts adjoining the outflow than from parts which are more remote from it. Thus is the *curve of saturation* or *water-table* as it is sometimes termed.

—" Agricultural Geology " by J. E. Marr, M.A., F.R.S.

The Weathering of Granite. Of the three constituents of a normal granite (i.e. quartz, felspar, and mica) the quartz is but slightly affected by solvents in the rain water and remains practically unchanged. Not so the felspar. This mineral, it will be remembered, is a double silicate of alumina and of a metal or metals of the alkalis or alkaline earths. The aluminium silicate is practically insoluble, but the alkaline silicate is soluble in carbonated water, and is converted into a soluble carbonate, which may be carried away in solution in river water. This change is of very great importance to us in two ways.

As orthoclase felspar, a common constituent of granite, contains potassium silicate, the resulting soluble potassium carbonate is rendered available for plant life. Again as the result of the chemical change, a mechanical change of profound import is brought about. The hard crystalline felspar is converted into a soft, incoherent mass of silicate of alumina known as kaolin or china clay. If the granite contains a large proportion of felspar the whole rock may be thus rotted, and indeed we frequently find that this rotting takes place for some distance below the surface of the ground. The weathered granite in parts of Cornwall may be dug out with a spade to a depth many feet below the surface. The rotten rock is thus rendered serviceable for further change into soil, and it is also brought into a state in which it is readily transported piecemeal to other places by the various agents of transport, such as running water. The ferro-magnesian constituent, such as mica or amphibole, is also acted upon to some extent.

—*Ibid.*

The Protective value of Latex. Though not of primary importance to the organism it must not be supposed that excretory products (such as latex) are of no value to the plant. They frequently serve an important *rôle* in the protection of the plants from their natural enemies and—from my experience—I am inclined to the belief that this is *one* of, if not the *principal* function of the latex in our rubber trees. As an instance of the protective value of the latex of the Hevea, I may mention a case that has recently come under my notice. A boxful of Longicorn beetles, with a bundle of young rubber stumps said to have been killed by them, was sent to me for report. The bark of these plants had been gnawed off in large irregular patches, exposing the bare wood...I found the roots to be attacked by a parasitic fungus pronounced by the Government Mycologist to be his recently discovered *Botryodiplodia elasticae.* It has always

seemed to me extremely doubtful that a healthy rubber plant, protected by the natural flow of latex, could be successfully invaded by bark-eating and boring insects, so I determined to make these particular beetles the subject of experiment. Several of the living insects were confined in a large cage together with a healthy growing plant of Hevea of the same age and stage of growth as those which had been the objects of the attack. The beetles crawled up the stem and presently tried their jaws on the bark. The puncture resulted in an instantaneous exudation of latex which adhered to the mouth parts of the beetles and was evidently very distasteful to them. They promptly abandoned the attack and spent some time in endeavouring to remove the sticky fluid. After the first rebuff no further attempt to feed was made—even under stress of starvation. After seven days' confinement without other food they were placed in another cage with *practically dried rubber plants and twigs of non-laticiferous* trees, upon which they commenced to feed greedily.

—Lecture on Rubber Diseases (Insect Pests) by Mr. E. E. Green (Ceylon Government Entomologist) on "Rubber in the East" (Peradeneya Manuals I.)

The Prevention of Plant Diseases.

Every estate is provided with a stock of medicines for use in cases of sudden sickness amongst the labourers. It is no less important that the health of the plants—upon which the labour depends—should be equally well provided for. Every estate should maintain a stock of insecticides and apparatus for their application, ready for every ordinary emergency. Such an outfit should at least consist of the following materials :—

Paris green	2 cwt.
Sulphur	2 cwt.
Whale oil soap	2 cwt.
Lime	50 bushels.
Sulphate of copper	1 cwt.

2 knapsack spraying machines for liquids
2 „ „ „ for distribution of powders

—The Government Entomologist (Ceylon) in "Rubber in the East."

Visits to Country Districts.

ONDERNEEMING.

The Director visited Onderneeming School Farm and went through the whole of the cultivation with the Agricultural Superintendent, who at the time of the visit was acting as Superintendent of the institution in the place of Mr. S. H. Bayley, away on leave. Considerable improvement has been carried out in the drainage. Some of the coffee fields are showing signs of falling off in their yields. It is proposed to plant Hevea, throughout these fields, with a view to replacing the coffee with rubber. The hevea trees at Onderneeming have made satisfactory growth in some situations, and they have increased in girth rapidly since they branched.

AGATASH.

The Assistant Director paid a visit to Agatash and inspected the lime cultivation there. The limes are making satisfactory progress, but in some situations are suffering from the effects of too much wind. The planting of wind-belts is being undertaken and several different kinds of trees are being experimented with. The system of keeping the land covered with a growth of weeds and grass is being generally adopted, and clean weeding is being given up. When this system of allowing weeds and grass to grow for surface mulching is adopted, it has been demonstrated that all bush must be kept down, or otherwise it tends to smother out the low-growing plants and grasses, and after weeding the land is left quite bare and is baked by the sun and washed by the heavy rains. A close-growing turf of grass and low-growing plants appears to be what should be aimed for in the cultivation of limes in this district. Two new 50-acre sections have been recently planted up, and they are now being planted throughout in pigeon peas, which will afford temporary shade for the young lime plants.

BONASIKA.

Tapping experiments have been continued at Bonasika rubber station with the indigenous *Sapium Jenmani*, and Fort Island has been visited in order to investigate the different species of *Sapium* growing there.

THE NORTH WEST.

A visit, extending over three weeks, was made to the North Western district to investigate the flora, and the different types of land to be found in certain sections of that district. Accompanied

by the Government Agent, and the Warden of the Arakaka district, the Assistant Director went up the Barima to Five Star, thence to Invincible, and across the new trail to the Whana, and finally back to Arakaka and Morawhanna. Samples of soils were collected, and some botanical specimens obtained. The Barima Mine was also visited. The Rubber experiment station at Issororo was thoroughly inspected. The trees are growing exceedingly well and already some interesting information has been obtained from the experiments being carried on. A new extension of 10 acres has been felled and laid out, and will be ready for planting up shortly. The rubber farms of Mr. David Young and of Messrs. Farnum and Smyth were also visited. Considerable improvement has taken place since the visit of last year; the trees are making satisfactory progress; they appear to be healthy, and the cultivation is receiving careful attention. Scale insects are to be found on some of the Sapiums, and the pruning of some sections needs attention. In some situations Sapium has grown much more rapidly than Hevea, while in others the Hevea looks distinctly promising. It is desirable that good wind-belts should be left when cleaning is being done, as constant winds are detrimental to the rapid development of rubber trees. The grant of Ned Harries was also visited, and some very large Sapium trees seen, but they are much too crowded together.

THE POMEROON.

The Assistant Director returned from the North West *via* the Pomeroon and inspected the work that had been carried out on the new experiment station being established at Covent Garden, near the Government offices at Marlborough. Practically all the work of digging the main drains and making the dams had been completed, and favourable weather was being waited for in order that burning could be done, and the laying out of the station undertaken. It is intended that this station should serve as a model station for the Pomeroon-Moruca district, and beds will be laid out in rubber, coffee, cacao, coconuts, limes, and provision crops.

DEMERARA RIVER.

The Agricultural Superintendent, after returning from Onderneeming, visited Land of Canaan on the Demerara River to advise in regard to cacao and rubber cultivation.

BERBICE.

The Head Gardener paid the usual visit of inspection to the Berbice Gardens, and also visited, at the request of the owner, the fruit cultivation of Mr. P. Murphy.

F. A. S.

Board of Agriculture.

SALE OF LIVE STOCK.

The annual sale of Government Live Stock from Onderneeming school farm and the Penal Settlement, was held in the paddock of the D'Urban Race Course on Wednesday, February 16, and attracted a large crowd, especially of East Indians. Mr. P. Wight, of Messrs. W. Bagot & Co., was the auctioneer, and disposed of the various lots with speed and satisfaction to bidders. Among those present were the Director of Science and Agriculture, the Assistant Director, the Hon. C. P. Gaskin and Mr. W. M. Payne (members of the Board of Agriculture), Mr. O. Weber (Secretary to the Board of Agriculture), the acting Superintendent of Onderneeming School (Mr. R. Ward), Mr. C. Shankland (Secretary to the Local Government Board), the acting Government Veterinary Surgeon (Mr. A. O'Leary), the Municipal Veterinary Surgeon (Mr. A. Seton Milne), Dr. Schroeff of Paramaribo (representing the Dutch Government), Messrs. W. Mearns, J. Russell, A. E. Bratt, H. Deverill, George Allan, J. A. King, Evan Wong, R. B. Howell, H. A. McLean, F. Mathias, H. Crawford and F. Burka.

The prices realized were fair, and in some cases —especially of the 'de Soto' stock from Onderneeming—good. Dr. Schroeff was a keen bidder for the better class animals and secured bulls at $39, $51, and $37, and heifers at $29 and $30. The best price was fetched by a three-year-old brown bull; the bidding for which started at $50 and rose to $85, when the hammer fell with the auctioneer's eye on Mr. Henry Crawford. A 10 months old Shorthorn-Holstein bull provoked a brisk duel between Dr. Schroeff and Mr. Geo. Allan; the latter retiring at $50. The best price for a cow was $56 given by Maharaj for a young Zebu-Barbadian cow with calf at heel.

DETAILS.

Details of prices and purchasers are appended.

BULLS.

Shorthorn-Holstein bull by "De Soto," 22 months old—Dr. Schroeff, Paramaribo .. ..$ 39

Shorthorn-Zebu bull, 3 years old—Henry Crawford 85

Shorthorn-Holstein bull by "De Soto," 10 months old—Dr. Schroeff	$ 51
Shorthorn-Zebu bull by "De Soto," 15 months old—Dr. Schroeff	37
Shorthorn-Zebu bull by "De Soto," 15 months old—Mr. F. Burka	29
Shorthorn-Zebu bull by "De Soto," 15 months old—Mr. Burka	66
Bull by half-bred Zebu out of creole cow, 10 months old—Mr. Vieira, Springhall	13
Bull by half-bred Zebu out of half-bred Shorthorn cow, ten months old—Mr. Evan Wong	15
Bull by half-bred Zebu out of creole cow, 10 months old—Mr. H. A. McLean, Vryheid's Lust	12
Bull by half-bred Zebu out of creole cow, 10 months old—Mr. J. McLean, Georgetown	11

COWS.

High grade imported Zebu cow with calf by "De Soto,"—K. Maharaj	37
High grade imported Zebu cow with calf by "De Soto,"—Mr. Vieira, Springhall	35
Half-bred Zebu cow, imported, with calf—Mr. F. Mathias, Georgetown	28
Young Zebu-creole cow with calf—Hoosainey, Bel Air	36
Young Zebu-creole cow in calf—Seetaram	22
Young Zebu-Barbadian cow with calf—K. Maharaj	56
Young Guernsey-Zebu cow in calf—Mr. J. Perreira	30
Guernsey-Creole cow with calf—Mr. S. H. Bayley	44
Barbadian cow with calf—Maharaj	34

HEIFERS.

Shorthorn-Zebu heifer, 18 months old—Mr. John Russell ..	11
Shorthorn-Zebu heifer, 18 months old—Mr. Evan Wong	10
Shorthorn-creole heifer, 14 months—Mr. A. E. Bratt	16
Shorthorn-Creole heifer, 13 months—Mr. A. E. Bratt.. ..	21
Shorthorn-Guernsey-Zebu heifer, 13 months old—Dr. Schroeff ..	29
Shorthorn-Guernsey-creole heifer, 14 months—Dr. Schroeff ..	30
Shorthorn-Barbadian heifer, 11 months—Mr. A. E. Bratt ..	21
Shorthorn-creole heifer, 21 months old—Mr. H. Deverill ..	26

BUFFALOES.

Bull—Maharaj	$ 30
Heifer—Maradeen	21
Heifer—Roopchan	29
Heifer—J. McLean	24

PIGS.

Mr. M. P. Camacho bought two half-bred Berkshire boars for $19 and $15. Pigs were bought by Messrs. R. B. Howell for $16, J. Junor for $11 and $12, Evan Wong for $15, and M. P. Lesser for $7.50 and $10.

FOWLS.

Game cocks went for from $2.50 to $3.50, and two sets of 3 half-bred Plymouth Rock hens went for $6.25 and $8.25.

Prolific Coconuts.

Mr. E. B Copeland, Dean of the College of Agriculture of the Philippines writes (to the Agric. Bull. S. and F. M. States.) " The Moro Plantation and Development Company has a (coconut) tree near Zamboanga, from which 106 nuts were taken at one cutting, and 112 two months later. I saw the tree less than two months later still, and it seemed to have fully a hundred nuts ready to harvest again."

Why Milk Deteriorates.

It seems to be very difficult for a great many dairymen to understand the importance of keeping milk clean—allowing no foreign substance like pieces of straw, dust and even particles of manure to get into the milk. They will tell you that they strain it through two thicknesses of cheese cloth, and remove all these foreign substances ; consequently the milk ought to be clean. The fact is, that straining the milk does not do so much good as they imagine. The hair or the bit of straw does not do so very much harm. It is the bacteria or microscopic organisms, little microscopic plants, adhering to these foreign substances which really do the harm, and these bacteria cannot be removed by straining the milk. The only thing to do is to keep them out in the first place.

—Queensland Agric. Journal. Dec. 1909.

Answers to Correspondents.

MAIN STREET : The green caterpillars you sent as specimens of the swarm attacking your ochroes were the larvæ of a Noctuid moth, *Cosmophila erosa,* which is a common and very widely distributed pest of malvaceous plants. They are not true "loopers" but are a very good imitation, as you say. Try spraying with the Paris green mixture recommended in Vol. III. No. 1, page 59 of this *Journal.*

Q. A. J.—Your crotons are infested with a species of *Orthezia* 'mealy-bug'; probably *praelonga.* The bushes seem to be in a terrible state, and must serve as a source of infection to the whole of your neighbourhood. Use the rosin compound recommended in Vol. III. No. 1, page 16 of this *Journal.* It is not too late yet to save the plants if you follow the advice given.

L. D. C.—The small black insects in your roses are *Thrips.* It is difficult to attack them effectively when they are in the flower but you might try "topping," which has met with great success in England when employed to combat a serious epidemic of *Thrips* on cultivated peas.

AMATEUR : Thanks for the specimens. The weed was *Amaranthus spinosus* and the caterpillars were the larvæ of *Xylomyges eridania,* a Noctuid moth extremely common all over America. It is very unwise to trust to caterpillars to keep down your weeds : much better use a cutlass. Weeds are often most convenient 'half-way houses' or 'jumping off places' for insect or fungus pests on their way to economic cultivations.

J. C. HUMPHREYS (Essequebo) : The shallot you enclosed seemed quite normal so far as we could see when it arrived here—we could detect no "parasites"—but the packing was faulty. Read the Directions for forwarding Diseased Specimens for Examination in any of the recent numbers of the *Journal.* Shall be glad to hear from you again.

S. G.—The soil you sent is a very heavy clay, and it is probable that Hevea would grow very slowly upon it, especially if your situation is at all wind swept.

DEMERARA RIVER.—Cacao does not grow well on pegassy soil, nor will Hevea unless it is well mixed with clay. (See the last number of the *Journal.*)

C. W.—The Hevea seeds are not seeds of *Hevea brasiliensis,* but approach more closely those of *Hevea Spruceana,* one of the hatties of this colony.

The Model Gardens.

Record of Attendances.

Below is given a table setting out the number of pupils who attended the Model Gardens of the colony, arranged in quarterly periods from April 1, 1907:—

	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Total Attendances.
1907								
April 1 to June 30	305	337	412	329	12	...	...	1,395
July 1 to Sept. 30	381	298	202	285	256	...	...	1,422
Oct. 1 to Dec. 31	575	293	380	221	288	...	...	1,757
1908.								
Jan. 1 to Mar. 31	597	731	389	299	187	...	...	2,203
April 1 to June 30	1,438	860	183	274	243	...	...	2,998
July 1 to Sept. 30	1,698	976	440	199	212	...	...	3,525
Oct. 1 to Dec. 31	1,714	819	465	115*	411†	160‡	...	3,684
1909.								
Jan. 1 to Mar. 31	1,638	710	338	463	370	302	...	3,821
April 1 to June 30	1,707	677	329	142	288	446	...	3,589
July 1 to Sep. 30¶	2,252	742	433	436	172	378	223‖	4,636
Oct. 1 to Dec. 31	1,876	536	438	236	362	771	439	4,858
1910.								
Jan. 1 to Mar. 31	1,282	769	287	370	259	489	465	3,921

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during the instruction given by the Superintendent Teacher. It has not yet been found feasible to keep a record of the many attendances during his absence.

* School in vacation November and December.
† Vacation in December.
‡ Instruction commenced in November.
¶ Schools in vacation during August.
‖ Instruction commenced in July.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to March 30 (1910). The corresponding figures for the three previous years are added for convenience of comparison :—

	1907 Jan. 1 to	1908 April 1.	1909 Jan. 1 to	1910. March 30.
Sugar, tons ...	21,014	22,544	27,099	20,000
Rum, gallons ...	576,145	323,243	607,135	575,652
Molasses, casks ...	372	44	57	445
Cattle-food, tons ...	1,837	1,085	2,379	2,131
Cacao, cwts. ...	157	55	20	19
Citrate of Lime, cwts.	...	...	3	70
Coconuts, thousands ...	19.8	97.6	134·5	115·5
Copra, cwts. ...	...	...	123	65
Coffee, cwts. ...	...	...	600	344
Cotton, lbs. ...	63	12	...	...
Fruit, brls. and crates	...	7	...	...
Ground Provisions, value	$717.84	$776.50	...	$15
Kola-nuts, cwts. ...	32	...	..	...
Rice, tons ...	840	1,246	1,084	1,650
Rice-meal, tons ...	...	...	382	460
Starch, cwts. ...	26	...	...	...
Cattle, head ...	283	289	115	259
Hides, No. ...	991	761	742	1,362
Pigs, No. ...	...	...	108	266
Poultry, value...	$ 172.88	$ 133.64	$ 3.12	$16.68
Sheep, head ...	27	1	...	6
Balata, cwts. ...	951	791	486	488
Charcoal, bags ..	19,027	19,311	22,708	17,612
Firewood, Wallaba, etc., tons ...	1,542	1,968	2,201	2,166
Gums, lbs. ...	2,532	264	...	...
Lumber, feet ...	27,599	6,196	6,606	32,182
Railway Sleepers, No.	1,000	500	1,000	...
Rubber, cwts.... ...	10	17	7	7
Shingles, thousands ...	230	889	194	380
Timber, cubic feet ...	102,257	111,755	99,920	78,451

Selected Contents of Periodicals.

The Development of Papua
Hurricanes and Hurricane Relief
—The Colonial Office Journal: Jan. 1910.

Suggestions for Pig-feeders
Wind Power
Tobacco Growing in Ireland
The Timber Supply of the United States
The New Nitrogenous Fertilizers
—Journal of the Board of Agriculture (England) Dec. 1909. Feb. and March 1910.

Agricultural Instructors and the Coffee Industry
Hints to Exhibitors at Shows
—Journal of the Jamaican Agricultural Society. Jan. 1910.

Spotted Rubber Biscuits
Miscellanea: Chiefly Pathological
Memorandum of a Tour in South India
—Tropical Agriculturist, (Ceylon) Jan. 1910.

Analytical Notes of Rubber Plants in the Botanic Gardens, Singapore
—Agricultural Bulletin of the S. & F. Malay States. Feb. 1910.

The Effect of Grass on Trees
—Gardener's Chronicle, Dec. 18, 1909.

Shield-budding the Mango
—Hawaii Agricultural Experiment Station, Bulletin 20, 1910.

Poultry for the Tropics.

"If required (in the Eastern Province) for the production of good layers, I would recommend Minorcas or Leghorns; if for table birds Plymouth Rocks or Wyandottes."

—Ceylon Government Veterinary Surgeon in "Trop. Agriculturist." January, 1910.

Planting Table.

The appended table, showing the number of plants to be allowed to an acre, was compiled by the late Mr. G. S. Jenman, F.L.S., as the result of his many years experience of tropical agriculture.

Avocado pears	per acre	75
Bananas	,,	150
Bread-fruit	,,	75
Coconuts	,,	75—80
Cacao	,,	150
Coffee (Creole)	,,	300
Kola	,,	150
Guavas	,,	250
Ground provisions (tannias, eddoes etc.)		1,500
Limes	,,	150
Oranges	,,	150
Mangoes	,,	75
Nutmegs	,,	150
Pine apples	,,	2,000
Plantains	,,	150

Distance in feet apart.	*No. of plants to the Acre.*
12 x 12	300
8 x 8	681
6 x 6	1,210
5 x 5	1,742
6 x 4	1,815
5 x 4	2,178
6 x 3	2,420
4 x 4	2,722
4 x 3	3,630
3½ x 3½	3,555
3 x 3	4,640

A Sign.

The irregular exudation of latex from the bark of a rubber tree is always a sign of some injury beneath the bark, and usually the occurrence of a fungus.

—H. N. Ridley, F.R.S., in "Agricultural Bulletin, F.M.S." Feb., 1910.

Forwarding Diseased Specimens for Examination.

In a former number of the Journal (Vol. i., pp. 53-5) hints were given as to the preparation, packing, and transmission of Specimens to the Government Botanist's office, but it is thought advisable to bring forward again the most essential points, for the guidance of those who have not the former article available.

(1.) A few fragments of a diseased plant are of practically no value for a scientific investigation. Sufficient material should always be sent, so that the primary cause of the trouble may be located.

(2.) Full particulars should be given as to the nature and extent of the damage done, the part of the plant attacked, the nature of the soil, drainage, the prevalence of the disease, when it was first noticed, and whether any similar kind of disease had been previously observed in the neighbourhood.

PACKING.

(3.) Specimens of portions of plants attacked by fungi may be sent green if packed in a well-ventilated box if the time taken for delivery is under 24 hours, but if delivery takes a longer time all leaves or soft fruits should be placed in a bottle or corked tube containing a solution made of 1 part of rum or methylated spirit and 2 parts of water. As many stages of the disease as possible should be sent, with notes as to the nature of each stage.

(4.) Living insects should always be packed with a supply of the plant on which they were found feeding, and the box should have some small holes pierced for purposes of ventilation. These should be carefully packed in such a way as to prevent their becoming crushed in transit.

(5.) Hard-bodied insects such as beetles, grasshoppers, bees, etc., may be killed by immersing in boiling water for about half a minute. They should be allowed to dry, be wrapped loosely in soft paper, each insect in a separate piece, and then packed in a strong box.

(6.) Butterflies and moths should be killed in a poison jar or by squeezing the body below the insertion of the wings. They must be handled carefully to prevent injury. Butterflies should have their wings folded back to back and each specimen separately folded in paper, while moths may be wrapped loosely in tissue paper.

(7.) All soft-bodied insects such as grubs, worms, plant-lice, etc., should be sent in small bottles preserved in diluted rum or other spirit.

FORWARDING.

All specimens should be accompanied with detailed particulars of the nature of the disease and should be addressed to:—

THE GOVERNMENT BOTANIST,
Botanic Gardens,
Georgetown.

INDEX TO VOL. III.

1909–'10.

A.

	Vol.	Page.
Abary Creek	III.	51
Aberdeen-Angus Cattle	III.	183
Acoushie Ants	III.	60, 186
Acid Soils. Para Rubber in—	III.	173
Agatash. Lime Cultivation at—	III.	47, 51, 68, 227
Agave rigida, var. *Sisalana*	III.	137, 156
Agriculture. Meetings of Board of—	III.	43, 125, 174
Agriculture and Fisheries. Board of—(England)	III.	9
Agriculture and its Problems	III.	112
Agricultural Banks and Co-operative Societies	III.	9
Agricultural & Forest Products. Exports of—	III.	58, 127, 189, 234
Agricultural Conference. The West Indian—	III.	4, 181
Agricultural Instructors	III.	8, 123
Agricultural Instructors. Districts assigned to—	III.	123
Agricultural Shows.	III.	119
,, ,, Reports of Local—	III.	121, 178
,, ,, Value of—	III.	167
Alcohol v. Petrol for Motors	III.	107
Air Saltpetre	III.	115
Amaranthus spinosus	III.	232
Amazon River	III.	161
Anopheles Mosquito	III.	149
Answers to Correspondents	III.	59, 128, 186, 232
Antheraea (genus)	III.	64
Anthrax	III.	29
Aphis	III.	146
Are Sweet Potato Vines Good for Horses?	III.	108
Armies and Sugar	III.	187
Avocado. Composition of Fresh—Fruit	III.	171
Arabian Coffee	III.	216

A.—Continued.

	Vol.	Page.
Associations. Grants to Farmers'— ..	III.	47
Aspidiotus articulatus	III.	69
Attacus hesperus, A. ricini, A. cynthia ..	III.	63
Attacus hesperus. Food plant of—	III.	65
Attendances at Model Gardens	III.	57, 124, 188, 234
Atmospheric Nitrogen. Leguminosæ and—	III.	169
Azotobacter	III.	5
Azolla	III.	60

B.

Bacillus radicicola	III.	169
Bacteria	III.	4, 113, 195 213
Banana. The—for export	III.	53
Banana Industry. The question of a— ..	III.	72
Banana Plants. Rubber from—	III.	70
Banana Commission. The	III.	176
Bananas	III.	117, 126, 128
,, The World's Trade in—	III.	73
,, Jamaican Methods of Cultivation	III.	78
,, The Surinam Contract	III.	83
Barbados. The—(Banana) Experiment ..	III.	77
Berbice Gardens	III.	119, 172, 228
Black-Heart of Pineapples	III.	60
Blastophaga grossorum	III.	69
Biliary Fever and Trypan Blau	III.	138
Board of Agriculture. Meetings of the—..	III.	43, 125, 174
Board of Agriculture and Fisheries. (England)	III.	9
Bonasika. Government Reserves at— ..	III.	25, 44, 50 118, 173, 179, 227
Bombyx mori	III.	63
Bordeaux Mixture	III.	59, 128
Boycing. The Results of—	III.	120
Brazil	III.	161
Bud Rot of Coconuts	III.	128
Bull. Shorthorn—	III.	182
Buxton Show. The	III.	119, 121

B.—Continued.

	Vol.	Page.
Building up of Carbohydrates in Plant Cells	III.	104
Burrs on *Hevea brasiliensis*	III.	9
Buck Indians	III.	116
British Guiana Sugar Cane Experiments..	III.	98
Brassolis sophoræ	III.	31, 147, 175
Books. Notices of—Received	III.	116
Botryodiplodia elasticæ	III.	225
Bourbon Cane. Yield of—	III.	46, 99

C.

Cacao. British Guiana Experiments with—	III.	102, 141
Cakes. Honey—	III.	220
Californian State University	III.	1
Canning in the Home	III.	213
Canal District. The	III.	119
Cane. (See Sugar Cane)		
Caprification (of Figs)	III.	70
Carbohydrates	III.	170
Carbohydrates in Plant Cells. The Building up of	III.	104
Carbon Bisulphide	III.	60
Carbon Bisulphide (For Rats)	III.	149
Castilloa elastica	III.	11
Castnia licus	III.	120, 150, 147 176, 187, 195
Cassava	III.	217
Caterpillar Pest of Coconuts. A	III.	31
Cattle. Shorthorn—	III.	229, 230
„ Polled Angus—	III.	183
„ Aberdeen Angus—	III.	183
Catch Crops	III.	163
Cedar	III.	180
Cell. The Plant—	III.	53
Cells. The Building up of Carbohydrates in Plant—	III.	104
Cellulose	III.	170
Chalcididæ	III.	69
Charcoal and Ducks	III.	222
Chicks. Newly-hatched—	III.	160

C.—Continued.

	Vol.	Page.
Chinese Bananas	III.	76, 128
Chionaspis citri	III.	69
Christianburg	III.	52, 118
Citrus Trees. Gum Troubles of—	III.	1
Clean Weeding v. Cover Crops	III.	162
Coal Tar or Stockholm Tar?	III.	212
Codlin Moth	III.	145
Coconuts. A Caterpillar Pest of—	III.	31
Coconuts. Drainage for—	III.	128, 186
Coconuts. Prolific—	III.	231
Coconut Cultivation. (Cost of)	III.	39
Coconut Palm. A Remarkable—	III.	110
Coffee	III.	125, 128, 166, 216
Colletotrichum	III.	59, 128,
Columbia. Exports of Bananas from ..	III.	74
Combustion in Plants	III.	113
Composition of Fresh Avocado Fruit ..	III.	171
Contents of Periodicals. Selected— ..	III.	61, 130, 190, 235
Controlling the "Gum-Tree Scale" ..	III.	155
Co-operative Societies. Agricultural Banks and—	III.	9
Core-Rot of Pineapples	III.	60
Corn Pone	III.	56
Corn Smut	III.	221, 212,
Corn (Maize) and Poultry	III.	215
Correspondents. Answers to—	III.	59, 128, 186, 252
Cosmophila erosa	III.	232
Cost of Establishing Plantations	III.	35
Costa Rica. Export of Bananas from— ..	III.	73
Cotton	III.	48
Country Districts. Visits to—	III.	50, 118, 172, 227
Courida. (*B. sophoræ* on)	III.	175
Cow Houses. More Light in—	III.	136
Crabwood	III.	180
Crops. Rotation of—	III.	54
Crops as an Insurance. Variety of— ..	III.	56
Crotophaga major	III.	67
Cutworms and their Cure	III.	30

C.—Continued.

	Vol.	Page.
Culex sollicitans	III.	149
Cultivation of Rice in British Guiana ..	III.	199
Cyclas formicarius	III.	128, 186
Cycle. The Nitrogen—	III.	4, 59
Cypropedium Fairrieanum	III.	71

D.

	Vol.	Page.
Dairy Returns. Recording—	III.	91
Demerara Silk Worm. The	III.	63
Demonstrations to Small Farmers ..	III.	122
Denitrification	III.	6, 7
Derris uliginosa	III.	129
Diseased Specimens. Forwarding— ..	III.	62, 131, 191, 237
Diseases. The Prevention of Plant— ..	III.	226
Distances. (For Planting)	III.	236
Distances. Planting—for Rubber	III.	198, 186, 236
Distoma hepaticum	III.	29
Districts assigned to Agricultural Instructors	III.	123
Districts. Visits to Country—	III.	50, 118, 172, 227
Drainage	III.	168
Drainage for Para Rubber	III.	162
Dressing for Harness	III.	165
Ducks. Charcoal and—	III.	222
Durantà Plumierii	III.	65
Duty of the Planter. The	III.	185

E.

	Vol.	Page.
Entomology. Practical—	III.	69
Epitheliosum contagiosum	III.	52
Eri Silk	III.	64
Eriococcus coriaceus	III.	155
Error in Field Trials. The Experimental—	III.	96
Evaporation and Soil Temperature ..	III.	55
Experiment. The Barbados (Banana)— ..	III.	77
Experimental Error in Field Trials ..	III.	96, 141
Experiments. The British Guiana Sugar-Cane—	III.	98

E.—Continued.

	Vol.	Page.
Experiments, The British Guiana Cacao— ..	III.	102
,, ,, ,, ,, Rice— ..	III.	102, 141
Experiments. The Farmer and—	III.	165
Experiments with Nitrogenous Manures	III.	195

F.

	Vol.	Page.
Farm Policy and Management	III.	114
Farmer. The—and Experiments	III.	165
Farmers' Associations. Grants to— ..	III.	47, 178
Farmers' Co-operative Demonstration Work	III.	122
Felspar	III.	225
Fertilizing Small Gardens	III.	23
Fertilizers. New Nitrogenous—	III.	195
Fertility of Partially Sterilized Soil. The	III.	195
Fertilization	III.	225
Fever. Biliary—and Trypan Blau	III.	138
Fever. Obscure—in Shorthorn Bulls ..	III.	183
Fever. Yellow—	III.	147
Ficus carica	III.	69
Ficus elastica	III.	20
Field Trials. The Experimental Error in—	III.	96, 141
Figs. (In S. Africa)	III.	69
Filaria	III.	148
Flea-Beetles	III.	59
Fly. The Typhoid or House—	III.	115
Fomes	III.	157
Forest Products. Exports of Agricultural and—	III.	58, 127, 189, 234
Food Value of Red Sorrel Seeds	III.	95
Formaldehyde	III.	104, 115
Fourcroya gigantea	III.	156
Fowls	III.	231
Freight. Excessive—on Timber	III.	181
Friendly Societies Act (England)	III.	10
Fruit Trees. Planting—	III.	3
Fruit Company. The United—	III.	74, 83
Fungi and Para Rubber	III.	140

F.—Continued.

	Vol.	Page.
Funtumia	III.	125, 180
Funtumia elastica	III.	11

G.

Garden Manures	III.	223
Gardens. Attendances at Model—	III.	57, 124, 188, 234
Gardens. Fertilizing Small—	III.	23
Geology of British Guiana	III.	117
Geological Collections. Upkeep of— ..	III.	178
Germinating Seed. The	III.	170
Grape Fruit. The Medicinal Qualities of—..	III.	196
Gros Michel Banana	III.	76, 128
Guinea Corn Experiments	III.	48
Gummosis. Prevention of—	III.	2
,, Treatment of—	III.	3
Gum-Tree Scale. Controlling the— ..	III.	155
Gum Troubles of Citrus Trees	III.	1

H.

Handbook of British Guiana	III.	116
Harness. Dressing for—	III.	165
Helicornia acuminata	III.	151
Hemp. Sisal—	III.	137
Hevea. Germination of—Seedlings	III.	139, 180, 197
,, Growth of—in N. W. District ..	III.	12, 17, 50
,, Protective Value of Latex	III.	225
,, No Food Material in—Latex ..	III.	20, 106
Hevea brasiliensis	III.	9, 11, 19, 44, 125, 158, 189, 161, 180, 186, 225, 227, 232
Hevea spruceana	III.	232
Hints Scientific and Practical	III.	53, 111, 168, 223
Honduras. Export of Banana from— ..	III.	174
Honey Cakes	III.	220
Humus	III.	113
Hygrophyte, Hygrophytic	III.	157

I.

	Vol.	Page.
Impatiens	III.	128
India Rubber. Lectures on—	III.	161
India Rubber Journal. The—	III.	70
Insects. To Evict—	III.	215
Inspection. Meat—	III.	27
Instructive Test. An	III.	126
Insurance. Mutual—of Live Stock	III.	192
Is Rubber a Waste Product ?	III.	106
Issorora Experiment Station	III.	11, 12, 50 228

J.

Jamaica. Rubber in—	III.	7
Jamaica. Export of Bananas from— ..	III.	73
,, Methods of Cultivating Bananas ..	III.	78
Jassidæ	III.	146
Java. Robusta Coffee in—	III.	216
Jenman. The—Memorial Clock	III.	47

K.

Khartoum. The Progress of—	III.	129
Klang. (Malay Peninsula)	III.	·149

L.

La Grange Show	III.	119, 121
Land Settlement Scheme. St. Vincent.—	III.	133
Large Moth-Borer of Sugar Cane	III.	150
Latex. The protective Value of—	III.	225
,, Irregular Exudation of—a Sign of Fungus	III.	236
Lecanium nigrum	III.	15, 128
Lecanium viride	III.	69
Lectures on India Rubber	III.	161
Leguminosæ and Atmospheric Nitrogen..	III.	169
Light in Cow Houses. More—	III.	136
Live Stock. Mutual Insurance of— ..	III.	192
,, ,, Annual Sale of—	III.	229
Liver-Fluke	III.	29
Locust. An Effective—Spray	III.	126
Locusts	III.	146
Losses. The Monetary—Caused by Insects	III.	145

M.

	Vol.	Page.
Malaria	III.	148, 197
Manaos	III.	161
Manihot	III.	125
Manihot Glaziovii	III.	44
,, *remanso*	III.	44
Manure for Sweet Potatoes	III.	108
Manures. Garden—	III.	223
Manurial Experiments with Rice	III.	141
,, ,, ,, Cacao ..	III.	143, 144
Market Stalls	III.	48
Meat Inspection	III.	27
Medicinal Qualities of Grape Fruit. The	III.	196
Milk. Colour of—	III.	126
,, The Transmission of Poisons to— ..	III.	26
,, Why—Deteriorates	III.	231
Model Gardens	III.	49, 177
Model Gardens. Attendances at—	III.	57, 124, 188, 233
Monetary Losses caused by Insects ..	III.	145
More Light in Cow Houses	III.	136
Mosquito. The Swamp—	III.	60
Mosquitoes	III.	149
Mosquitoes. Larvicide for—	III.	129
Motors. Alcohol v. Petrol for—	III.	107
Moth Borer. The Large—of Sugar Cane ..	III.	150
Musœae. (Rubber from)	III.	71
Mutual Insurance of Live Stock	III.	192
Mytilaspis citri	III.	69

N.

Natal. Sugar in—	III.	107
Newly Hatched Chicks	III.	160
New Nitrogenous Fertilizers	III.	195
Nicaragua. Exports of Bananas from— ..	III.	74
Nitrification	III.	6
Nitrolim	III.	195
Nitrogen. Leguminosæ and Atmospheric—	III.	169
Nitrogen Cycle. The	III.	4, 59
Nitrogenous Fertilizers. New—	III.	195
North-Western District. Rubber in— ..	III.	11, 228

N.—Continued.

	Vol.	Page.
Notes	III.	8, 67, 137, 195
Notes on Orchid Growing	III.	109
Notices of Books Received	III.	116

O.

	Vol.	Page.
Onderneeming. Cacao at—	III.	103
,, Robusta Coffee at— ..	III.	166
,, *Inspections of*—	III.	50, 118, 173, 227
,, Stock at—	III.	49
Orchid. A Lost—Discovered	III.	71
Orchid Growing. Notes on—	III.	109
Orestes	III.	184
Orthezia prælonga	III.	232
Osmosis and the Plant	III.	112, 223

P.

	Vol.	Page.
Palm. A Remarkable Coconut—	III.	110
Papuan Native. The	III.	67
Para Rubber	III.	35, 157, 159
Para Rubber. Fungi and—	III.	140
Para Rubber in Acid Soils	III.	173
Paris Green. (For Flea Beetles)	III.	59
Peat Soils. Rubber Cultivation in— ..	III.	156
Pegass Lands	III.	51
Pegass Soils. Treatment of—	III.	111
Penal Settlement	III.	51, 118
Periodicals. Selected Contents of— ..	III.	61, 130, 190, 235
Pest. A Caterpillar—of Coconuts	III.	31
Petrol. Alcohol v.—for Motors	III.	107
Phosphatic Slag and Ground Phosphates	III.	112
Pigs	III.	231
Piroplasmata	III.	138
Plant Cell. The	III.	53
Plant Cells. The Building up of Carbohydrates in—	III.	104
Plant Diseases. The Prevention of— ..	III.	225
Plant. Osmosis and the—	III.	112

P.—Continued.

	Vol.	Page.
Plantains. Disease of—	III.	187
Plants. Combustion in—	III.	113
Pln. Providence. Lime Cultivation at—	III.	172
Plantations. The Cost of Establishing—	III.	35
Planter. Science and The—	III.	194
Planter. The Duty of The—	III.	185
Planting Distances for Rubber	III.	186, 198
Planting Fruit Trees	III.	3
Planting Table	III.	236
Plough. When to—	III.	55
Poisons. The Transmission of—to Milk	III.	26
Pomeroon	III.	51, 118, 228
Poultry. (Pars. on)	III.	140, 165, 187, 215, 235
Poultry for the Tropics	III.	235
Poultry and Corn	III.	215
Practical Entomology	III.	69
Prevention of Plant Diseases. The	III.	225
Prices. Jamaica (for bananas)	III.	82
Prize. A Tempting—	III.	17
Prolific Coconuts	III.	231
Protective Value of Latex. The	III.	225
Prussic Acid. (In Sweet Potato Vines)	III.	108
Public Opinion	III.	140
Puddled	III.	168
Pusa. Agricultural Research Institute at—	III.	64
Pyrropyga	III.	59

Q.

Question of a Banana Industry. The	III.	72

R.

Raiffiesen Union	III.	10, 193
Rationale of Rubber Tapping. The	III.	18
Rats in Rice Fields	III.	149
Raw Material	III.	67
Red Creek Natives	III.	67
Red Sorrel Seeds. Food Value of—	III.	95
Reports of Local Shows	III.	121
Reports on Sapium Rubber	III.	24

R.—Continued.

	Vol.	Page.
Rhizobius ventralis	III.	155
Rice	III.	126, 182, 199
Rice. Yields of Local—	III.	208
Rice. Enemies of—	III.	209
Rice. Experiments with British Guiana— ..	III.	102,141, 181
Rice Fields. Rats in—	III.	149
Rices from India. Specimen—	III.	68, 126
Robusta Coffee	III.	125, 128, 166
Rosin Compound	III.	16, 60, 69, 128
Rotation of Crops	III.	54
Rothamsted	III.	97
Rubber Cultivation in Peat Soil	III.	156
,, in B. G. Diseases and Treatment of—	III.	15
,, in Jamaica	III.	7
,, from Banana Plants	III.	70
,, in the North Western District ..	III.	11, 137, 210
,, Is—a Waste Product	III.	106
,, Our —Number	III.	8
,, Para—	III.	35
,, Planting Distances for—	III.	186, 198
,, Reports on Sapium—	III.	24
,, Seedlings. (Germination of) ..	III.	139
,, Tapping. The Rationale of— ..	III.	18

S.

	Vol.	Page.
St. Vincent. Land Settlement Scheme in—	III.	134
Saltpetre. Air—	III.	114
Sansevieria (hemp)	III.	157
Sapium Jenmani	III.	11, 19, 43, 44 125, 179, 186 210
,, ,, Growth of in—N. W. ..	III.	12, 17, 24, 26 50
,, ,, Scale Insects on—	III.	15, 60, 125, 211, 228
Sapium Rubber. Reports on—	III.	24
Saturniidæ	III.	64
Scale (Insects)	III.	125, 155
Scale Insects. Control of—by Lady Birds	III.	155

S.—Continued.

	Vol.	Page.
Scale Insects. The Value of Spraying for—	III.	68
Science as a Time Saver	III.	194
Science and the Planter	III.	194
Scorching Explained	III.	223
Sea Island Cotton	III.	125
Secret of Success (Poultry). The ..	III.	187
Seed. The Germinating—	III.	170
Seedlings. Abnormal Hevea—	III.	197
Seedling Canes	III.	100, 125
Selected Contents of Periodicals ..	III.	61, 130, 190, 235
Shorthorn Bull	III.	49, 182
Silk. Eri	III.	64
Silk. Tussur	III.	64
Silk Worm. The Demerara—	III.	63
Silk Worms	III.	59, 64
Singapore	III.	120
Siruaballi	III.	180
Sisal Hemp	III.	157
Sisal and Soil	III.	137
Slag Phosphate and Ground Phosphates ..	III.	112
Small Holdings	III.	135
Smother Crops	III.	126, 227
Smut (of Maize)	III.	129, 186, 221
Soil. The Fertility of Partially Sterilized— ..	III.	195
Soils. Para Rubber in Acid—	III.	173
Soils. Rubber Cultivation in Peat— ..	III.	156
Soils. Treatment of Pegass—	III.	111
Soil Temperature. Evaporation and— ..	III.	55
Sore Head of Turkey Poults	III.	52
Sorrel. Food Value of Red—Seeds	III.	95
Specimen Rices from India	III.	68
Spraying for Scale. The Value of— ..	III.	68
Sprayers. (Knapsack, etc.)	III.	16, 187, 226
Spray. An Effective Locust—	III.	126
Stalls. Market—	III.	179
Starch	III.	170
Starch in Maize, Potatoes and Cassava ..	III.	219
Stock. Annual Sale of Live—	III.	229
,, Mutual Insurance of Live—	III.	192
Sugar. Armies and—	III.	187

S.—Continued.

	Vol.	Page.
Sugar. (A Carbohydrate)	III.	170
Sugar Cane Committee. (Board of Agriculture)	III.	102
Sugar Cane. Cost of—Cultivation	III.	42
Sugar Cane. B. G.—Experiments	III.	99
Sugar Cane. The Large Moth-Borer of— ..	III.	150
Sugar in Natal	III.	107
Surra in the Malay States	III.	45
Surinam	III.	59, 119
Swamp Mosquito. The	III.	60
Sweet Potatoes. To Ascertain the Ripeness of—	III.	103
,, ,, Food Value of—.. ..	III.	120
,, ,, Vines. Are—Good for Horses	III.	108
Sweet Potato Weevil	III.	128

T.

Table. Planting—	III.	236
Taenia ecchinococcus	III.	29
Tapioca	III.	218
Tapping. (Of Rubber Trees)	III.	164
Tar. Coal—or Stockholm— ?	III.	212
Tar for Wounds of Para Trees	III.	140, 212
Temperature. Evaporation and Soil— ..	III.	55
Tempting Prize. A	III.	17
Termes Gestroi (in rubber plantations) ..	III.	17
Thomas Slag	III.	112
Thrips	III.	232
Timber. (Excessive Freight on)	III.	181
Treatment of Pegass Soils	III.	111
Trichina spiralis	III.	29
Tropics. Poultry for the—	III.	235
Trypan Blau. Biliary Fever and—	III.	138, 184
Tuberculosis	III.	28
Turkey Poults. Sore Head of—	III.	52
Typhoid or House Fly. The	III.	114

U.

	Vol.	Page.
United Fruit Co. The	III.	74, 83
Ustilago maydis	III.	129, 186, 212

V.

Vacher. On Food Inspection	III.	27
Value of Agricultural Shows	III.	167
Value. The Protective—of Latex	III.	225
Vaporite	III.	215
Variety of Crops as an Insurance	III.	56
Veterinary Department. (Transfer of) ..	III.	177

W.

Wakenaam	III.	173
Water-Table. The	III.	224
Weathering of Granite. The	III.	225
Weevil. Sweet Potato—	III.	128
Welcome Research Lab. Report	III.	129
When to Plough	III.	44
White Ants	III.	17
Whittier Laboratory	III.	2
Why Milk Deteriorates ?	III.	231
Why Not Ask ? (Note)	III.	8
Wind Effect on Rubber Trees	III.	159, 162
Witch-Broom Disease of Cacao	III.	59, 119,128
Woburn Experimental Fruit Farm ..	III.	3
Woods. Reports on Local—	III.	180

X.

Xerophyte. Xerophytic	III.	157
Xylomyges eridania	III.	232

AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE LIBRARY
No. 1321
28 MAY 1936
COIMBATORE